

THE A·LIETZ COMPANY
SAN FRANCISCO U·S·A



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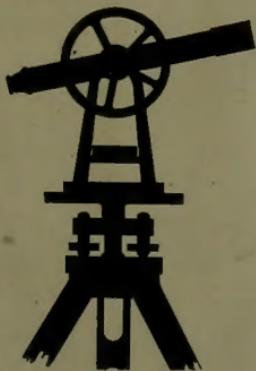
1926



MANUFACTURERS OF

**ENGINEERING, SURVEYING,
MINING *and* NAUTICAL
INSTRUMENTS**

**DRAWING MATERIALS
FIELD EQUIPMENT**



THE A. LIETZ COMPANY

Established 1882

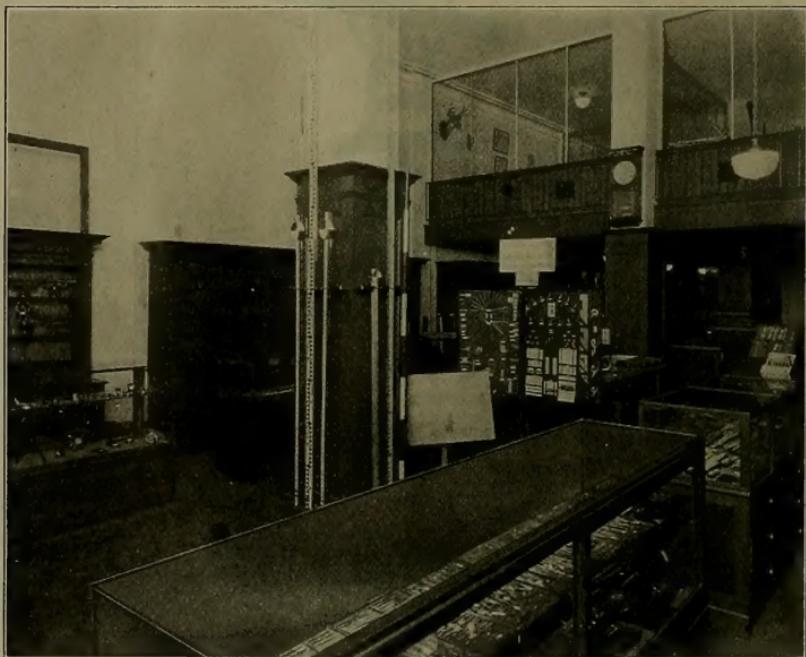
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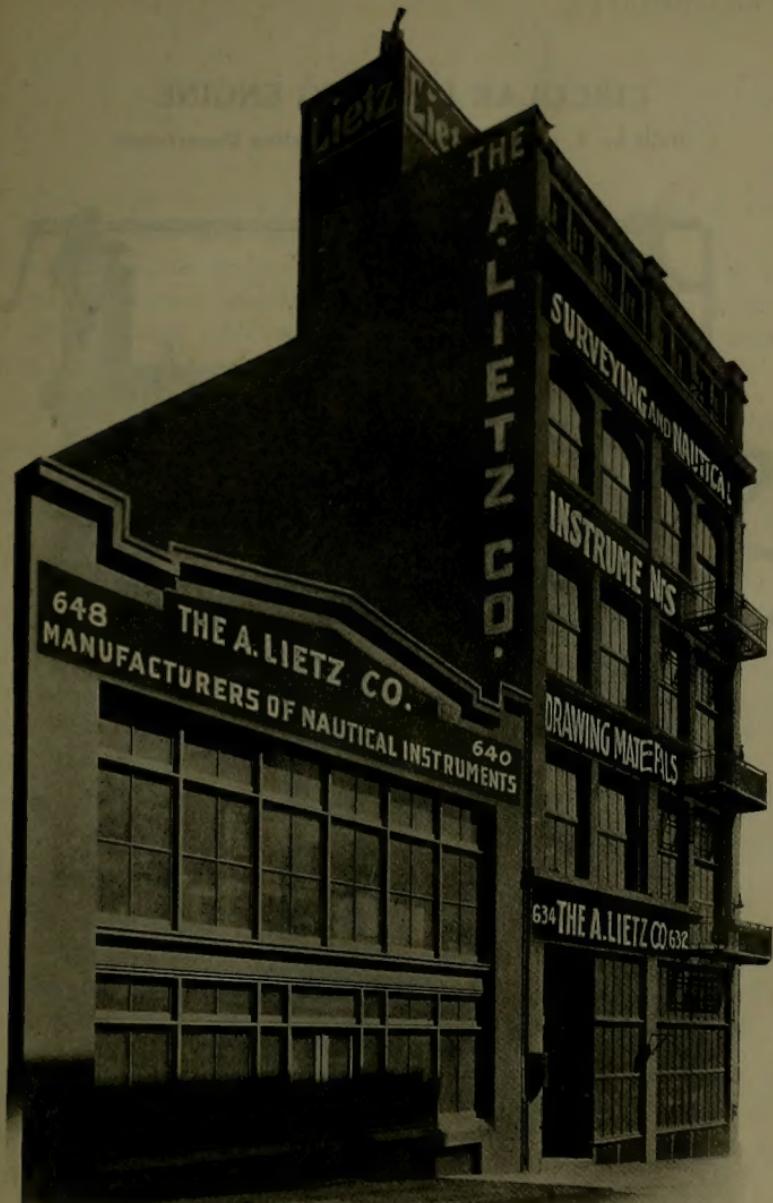
SAN FRANCISCO, U. S. A.



EXTERIOR OF THE A. LIETZ CO. SALESROOMS
61 Post Street, San Francisco, U. S. A.



INTERIOR VIEW OF THE A. LIETZ CO. SALESROOMS

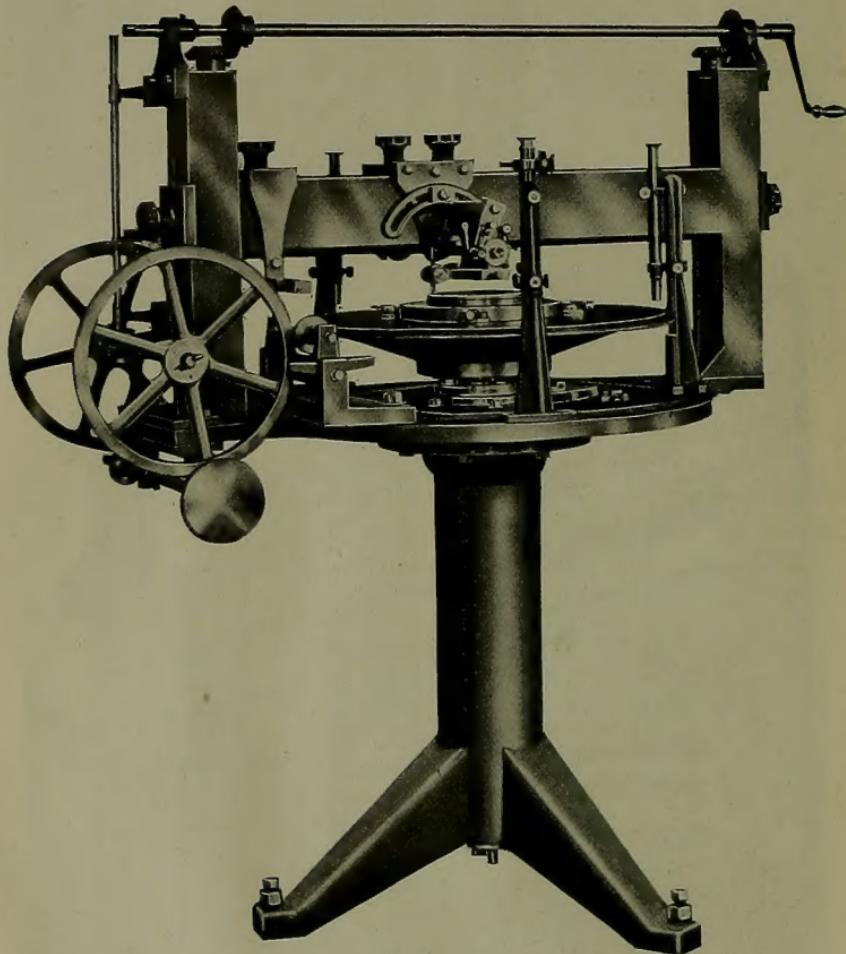


THE A. LIETZ CO. FACTORIES

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

CIRCULAR DIVIDING ENGINE

Built by A. Lietz Co. for the Graduating Department



We are in position to regrade the arcs or circles of all makes of surveying instruments; also sextants, octants, protractors, etc. Prices on application.

PREFACE

The articles manufactured by this Company are quoted at prices consistent with their quality of workmanship and material. We endeavor to place before the public the very best that can be produced or obtained, without imitating in shape or design the products of other makers. All our articles are of the most recent standard, with every known improvement.

The manufacture of American engineer's instruments constitutes an industry of National importance, inasmuch as the construction of them is of specific American origin; which has made it possible from the beginning (in about 1832) to accomplish engineering problems with that amount of speed and obtain results within the limitations of accuracy which characterizes many of our American industrial problems.

It is realized that those American manufacturers who have devoted their efforts to the construction of first-class instruments only have been the pioneers in establishing the standardization of the American engineer's instruments of today.

It is also realized and fully established by experience that the first-class instrument is in any and every instance the most advantageous to use.

Economic efficiency can only be obtained with the use of first-class instruments which are kept in good working condition by keeping them out of the hands of the ordinary mechanic, who frequently attempts to make repairs which can only be executed by the manufacturer.

Lietz Transits, Levels and Alidades are precise, sensitive and strong and assure their purchasers a lasting satisfaction in the field and as an investment.

Quality evidenced since 1882.

THE A. LIETZ CO.

NOTA

Este manual reemplaza las ediciones anteriores de nuestro catálogo y está cuidadosamente revisado y corregido a la fecha.

Al formar pedidos guiados por el catálogo, sírvanse mencionar el número, nombre y la medida del artículo. Al telegrafiar pedidos por instrumentos de agrimensura, usen palabras de clave, para comodidad.

Nuestros precios son F. O. B. San Francisco. Transportación de mercancías enviadas a vistas ó para su examen, es a cargo del cliente.

Sírvanse tener cuidado de mencionar el Distrito y Estado al dar su dirección, haciendo la en cada caso tan clara como sea posible.

No cobramos los empaques, con excepción de embarques para el extranjero que requieran cajas especiales y cuidado. Cuando no recibimos instrucciones especiales, usamos nuestro propio criterio acerca de la manera de embarcar y pagaremos anticipados los gastos de transportación si así se desea, agregando esas sumas a la factura.

Garantizamos todas las mercancías manufacturadas por nosotros, y cualesquier artículos que no resulten satisfactorios pueden devolvérseños y nosotros los cambiaremos gustosos. Si no estuvieren satisfechos, sírvanse escribirnos.

Nuestra política es satisfacer a nuestros clientes, porque creemos que los clientes satisfechos son nuestro más alto caudal.

De acuerdo con las reglas de Express Company, un instrumento de agrimensura, cuidadosamente colocado en su caja y en una caja de empaque, es despachado como mercancía y se cobra "tarifa sencilla." Triple tarifa es aplicada si no se observa esa precaución. Por consiguiente, el cliente no deberá omitir conceder estricta atención a esta regla y evitarse cargos excesivos.

Cajas de empaque para instrumentos de agrimensura, son proporcionadas por nosotros a muy bajo costo.

**MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS** THE A. LIETZ COMPANY
SAN FRANCISCO, U. S. A.

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BY

THE A. LIETZ COMPANY

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NOTICE

This manual supersedes the former editions of our catalogue and is carefully revised and corrected to date. Kindly destroy old issues.

When ordering from catalogue please give numbers, the name and size of article. When telegraphing orders for surveying instruments use code words for convenience.

Our prices are F. O. B. San Francisco. Transportation on goods sent on memorandum, or for examination, is at the expense of the customer.

Please be careful to add the county and state to your address, making it, always, as clear as possible.

We make no charge for packing, except on foreign shipments requiring special cases and care. Unless otherwise ordered we shall use our best judgment in the way of shipping, and will prepay transportation if desired, adding amounts to your invoices.

We guarantee all goods sold by us, and any articles which do not prove satisfactory should be returned to us, and we will cheerfully rectify or replace.

It is our policy to please our customers, believing that satisfied patrons are our highest asset.

According to the rules of the Express Companies, a surveying instrument, carefully placed in its case and in a packing box, is shipped as merchandise and charged at "single rate." "Three rates" will be charged if this precaution be not taken. The customer should not omit, therefore, to pay strict attention to this rule and avoid unnecessary overcharges.

Packing boxes for surveying instruments are furnished by us at a nominal rate.



VIEWS OF OUR MANUFACTURING DEPARTMENT

DESCRIPTION OF
THE LIETZ INSTRUMENTS
INCLUDING REMARKS ON THEIR USE, HANDLING, CARE,
PRESERVATION AND ADJUSTMENTS

THE ENGINEERS' TRANSIT OR THEODOLITE

In reviewing the different parts of the transit and theodolite, it will answer our purpose to include them, for the present, under one head, using both terms as synonymous—the word theodolite having been defined as an instrument of angular measure, possessing two graduated circles, normal to each other, which during manipulation are set in horizontal and vertical planes respectively. Authorities say that it is generally believed that the word theodolite (theodolith) is a combination of θεα sight, στόος road, and λιθος stone, and that in order to understand this derivation it must be known that formerly all supports upon which theodolites were placed were made of stone. This meaning, however, seems somewhat ambiguous, and other derivations have been sought. The etymology of the word is uncertain.

In classifying there appear two distinct groups of theodolites: the simple theodolite, in which the lower clamp and tangential movement is neglected; and the repeating theodolite, possessing the double horizontal movement on spindle and plate, which is the principal feature of all complete field instruments made for the engineer at the present time.

The various parts of the transit or theodolite may be grouped under the following heads, viz.:

Beginning from the base-plate we have:

- 1—The tripod connection with the leveling, plumbing and centering apparatus (Page 10);
- 2—The centers (Page 11);
- 3—The graduated plate and verniers (Page 11);
- 4—The compass and variation plate (Page 13);
- 5—The standards with the vertical arc and its movements (Page 15);
- 6—The gradienter (Page 16);
- 7—The spirit levels (Page 16);
- 8—The telescope (Page 17).

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1. Tripod Connection

This is effected by the ordinary screw method, which has proven to be the most popular among the engineers of today.

Leveling Screws

As these are used more than any other part of the instrument, it is evident that they should be very durable. Those of the Lietz make possess a very deep thread, rounded a little on the edge, which insures a very smooth motion and greater durability than sharp-edged threads. The screws are made of composition metal.

The lower construction of the transit is made with the view of affording the greatest steadiness under all conditions.

The whole construction of this part is intended to insure the absolute steadiness of the instrument, and to give it rigidity even in a strong wind; and, since this is one of the prerequisites of an instrument of precision, we have laid particular stress upon our leveling arrangement, which is of the most approved modern design.

For instruments of the greatest precision, as those used in triangulation or geodetic work, it may be an advantage to arrange the base with three leveling screws instead of four. These changes will always be made upon application. While the ordinary complete transit is more compact and of greater utility with four screws, in a specially designed instrument for geodetic work it will always be well to consider the advantages of the three-screw system.

Shifting Center for Facilitating Plumbing and Centering

All our complete instruments are furnished with shifting plates for the purpose of setting them precisely over a point, after having approximately done so by the tripod legs. This arrangement is of the greatest utility to the field man, and we are convinced that those who have adopted it will never again dispense with it.

While it does not make the instrument less rigid or portable, it is so easily manipulated, and becomes a great labor-saving factor. In order to center the instrument accurately, two of the leveling screws require a slight loosening, when the transit may be shifted upon the tripod until the center of the plumb-bob is directly over the point to be occupied. The screws are then turned down and the instrument leveled up in the usual manner, when it will stand as firm upon its base as required.

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2. The Centers

In manufacturing this all-important feature, the very backbone of the instrument, too much care and attention cannot be bestowed.

It is essential that both of these metal axes should have the same absolute center as the graduated plate and the horizontal telescope axis, whichever way the instrument may be turned. This is accomplished by the A. Lietz Company by making this detail a specialty. The carefully chosen material for the vertical axes, the exact method of turning and fitting them, and the precision reached in the manner of centering them, together with the subsequent scrutinizing test to determine the slightest eccentricity, have accomplished results as perfect as mechanical means and human ingenuity can achieve.

Eccentricity has been a source of annoyance and error to the engineer, to determine same a number of practical methods have been invented and put to use.

But with our modern transit, if used with ordinary care, this source of error has been eliminated, or at least reduced to the lowest possible minimum.

3. The Graduated Plate

We have now come to the most essential part—the very soul of the instrument. It is needless to dwell upon the necessity of an accurate graduation; it is self-evident, and it becomes the instrument-maker's pride to make it so.

We guarantee our work in this particular as perfectly reliable, the graduation lines straight, thoroughly black and of uniform width.

The plate is accurately centered and free from eccentricity, as already explained. Illustrations shown on pages 48 and 49.

The horizontal circle is graduated from 0 to 360 degrees, with two sets of figures running in opposite directions (unless ordered differently). They are large and distinct, and, to avoid errors in reading, the figures of these two sets, and those on their corresponding verniers, are inclined on opposing slants, thus indicating the direction in which the vernier should be read.

We recommend graduations on a solid *silver* ring, as that metal offers many advantages for the purpose—in fact, its great permanency and smoothness render it the only satisfactory surface for fine graduations.

It is customary with us to graduate circles so that they may be read to single minutes or thirty seconds of arc. We make any degree of refinement called for, but our manufactured goods are always on hand in the two vernier divisions named.

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The Vernier

This consists of a small sliding scale, movable upon a larger one, so graduated that n parts thereof shall include either $n + 1$, or $n - 1$ parts of the larger scale. The scale may be applied to either straight lines or arcs, and aids to determine the smaller divisions of measure between the lines on the larger scale. See illustrations Pages 48 and 49.

A tedious method for measuring small values of arc by means of concentric circles was given in the early part of the sixteenth century by a Portuguese, Pero Nuñez (Nonius), and after him the name of *nonius* is still applied in European countries to what we exclusively call a *vernier* here. This term was justly given it in honor of the Dutch captain, Peter Werner, who gave to the scale the sliding shape in which we now apply and use it practically. Signing himself "Pierre Vernier" in a discussion of the "Nonius," written by the inventor in the French language and published in Brussels in 1631, gave rise to the term we now almost universally employ.

The graduations on a vernier are usually so made that n divisions thereof shall equal $n - 1$ divisions on the circle.

It becomes a simple problem to determine the value of n from the following equation:

Let l = length of one division on circle,

l_1 = length of a vernier division, it is evident that

$$l(n - 1) = l_1 n, \text{ or}$$

$$n = \frac{l}{l - l_1}.$$

The value of any quantity in the equation may then be readily expressed in terms of the other; $l - l_1$, or the smallest readable division, being equal to $\frac{l}{n}$.

It is customary to graduate the circles of the Lietz transits in 20-minute divisions, reading to either 20 or 30 seconds on the vernier.

The value of n in these cases is $\frac{20 \times 60}{20}$, or 60 in the former, and $\frac{20 \times 60}{30}$, or 40 in the latter; or, in other words, 59 and 39 divisions on the circle will correspond to 60 and 40 on the vernier respectively. Instruments reading to one minute of arc are divided to 30 minutes on the plate; in that case 29 circle spaces are equal to 30 vernier spaces.

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The verniers should be covered with glass to protect them from exposure, and for ease in reading they should be provided with ground glass shades.

Our verniers are in such position that the observer need not step aside in order to read them, for we place them about 30 degrees from the line of collimation.

The space between the circle and the vernier must appear, through a magnifying glass, like a fine black line. No accurate reading can be taken if the space appears wider than a mere line of *uniform* thickness under the revolution of the plate.

Clamp and Tangent Screws

All tangent clamps are of a recent superior design, the section of which is an even cross which together with a connecting piece between the spring case and tangent screw socket in the lower clamp insures an amount of rigidity heretofore unknown.

The tangent screws are made of a special alloy and have special 45° angle threads, which also insure continuous uniform wear and stability.

4. The Compass

Lietz compass needles are made of the highest grade of permanent magnet steel; their shape is symmetric and the weights so proportioned as to give the best results. Our experience with the mariner's magnetic compass, which we manufacture for the United States Navy, where the highest degree of permanent magnetic force is required, has put us in a position to adapt this to our engineer's magnetic needles.

The closest attention is given to the center cap—which contains an agate setting—and to the pin upon which the needle rests, for the accuracy or sensitiveness depends principally upon these two details. These needles possess that degree of sensitiveness required in a high-grade instrument. A sluggish needle—one that will hang like a dead load—is not fit for the observation of a reliable azimuth.

The center pin must occupy the true center of the graduated circle, and must stand normal to its place. We utilize precise instruments with high magnifying power to obtain the absolute true position of the pin, in order to avoid all errors due to eccentricity.

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The *lifting arrangement* is applied with the view of raising and lowering the needle gently and gradually, as any sudden drop to the pin, or any quick action of arresting its motion, is sure to cause a rapid wearing of the point and the cap.

The *compass* is divided into 30-minute divisions, and numbered from 0 to 90 degrees in each quadrant from the north and south points. This is done to conform with the usual practice of surveyors in this country to record bearings in the four quadrants. But any desired method of numbering the compass, either from 0 to 180 degrees, or from 0 to 360 degrees, may be had upon application.

In order to record at once the true bearings in the field instead of the magnetic, the instrument can be provided with a *variation plate*, *i. e.*, an arrangement for laying off the local deviation of the needle by a movement of the graduated compass ring, so that the indicated course of a line shall show at once its relation to the true meridian. It is so made that the variation may be laid off with precision to the minute, by the aid of the instrument's vernier.

This is done in the following manner:

Having set the plate vernier to zero, adjust the instrument and, with the aid of a good reading glass, place it in such a direction that the north end of the needle shall point to the zero of the compass ring, which latter must coincide with the little pointer provided for that purpose. Having carefully set the instrument thusly by means of the lower clamp and its tangent screw, which can certainly be done to the nearest minute of arc, we release the clamp of the plate and proceed to lay off the amount of the local deviation of the needle in degrees and minutes by means of the plate-vernier—to the right if the variation be east. The instrument is now again in a fixed position, the telescope pointing to the true north, or as much to the left of the needle as the magnetic variation is east. We now proceed to turn the ring until its zero shall coincide exactly with the north end of the needle, when every subsequent reading of the compass, in any position, will indicate the bearing of the vertical telescope axis from the true meridian.

This simple little device is fully up to the standard of accuracy required, for with care in setting the needle we can always obtain results correct within the nearest minute. We find that by this method the additional vernier, usually placed inside of the compass ring, becomes superfluous, as the plate and vernier of the transit are perfectly capable of taking care of the duties of this unnecessary accessory.

The variation plate has proven a great labor-saving device, as the observed courses require no reduction to the true meridian subsequently. It is now almost universally called for; and for those practitioners with whom land surveying is a specialty we should, by all means, recommend it as an indispensable feature.

5. The Standards and Vertical Arc

The standards are so constructed as to give the maximum support to the telescope, commensurate with the size of the plate. They are light, but rigid and strong.

To avoid unequal expansion of the metal in the standards by exposure in the hot sun, which has a tendency to elevate one end of the telescope axis and to depress the other, vitiating the adjustment, they are now what we call "Torchon" finished. This finish, being a non-conductor of heat, reduces to a minimum this source of possible error, which, in very sensitive instruments, is of sufficient moment to be guarded against. Other parts of our instruments are also finished in the same manner, particularly Level telescopes, which we shall have reason to mention again hereafter.

The bearings for the telescope axis are made with extra care and attention.

The axes of the Lietz transit telescopes are cut to conical or cylindrical bearings. The advantage of this is very evident, in that there is less friction than by any other contact; and, in addition to that, it affords a much finer fitting by reason of its shape. But it is *very essential* that the *hardest metal* should be used for this purpose, as a material of insufficient hardness would soon wear, and the axes would become elliptical.

One of the standards is supplied with an adjusting device to regulate any inaccuracy in the motion of the telescope in the true vertical plane, when the centers of the instrument stand vertically.

One standard carries the arc for observing vertical angles, which may be either a full or a half-circle, as the customer desires. It is usually made to read to minutes, but may be graduated finer if so ordered. A clamp and tangent screw are provided on the right-hand standard, which are made like those already described for the horizontal movement. Every part of the vertical measuring apparatus is strongly and accurately made and fitted, to insure the best results in its practical application.

6. The Gradienter

The head of the tangent screw of the vertical arc movement is made somewhat larger, properly silvered and graduated into a number of equal parts on its circumference, the thread of the screw being cut with great precision, so that its revolution may be accurately recorded by the divisions of the micrometer head. See illustration page 69.

One complete revolution of the screw corresponds to $\frac{5}{10}$ of a foot of difference in level in 100 feet. Since the head is divided into fifty parts, it follows that one division equals a difference of $\frac{1}{100}$ of a foot in 100 feet. We furnish this with a movable head admitting a zero setting.

With this attachment grades may be established very quickly. It is only necessary to set the screw head to zero, level and clamp the telescope, and turn the screw up or down as many spaces as there are hundredths of a foot of rise or fall in one hundred feet of the grade to be laid out. With the small scale over the screw thrown back, the gradienter is used as an ordinary tangent screw. It is one of the most useful accessories, is easily applied, and adds nothing to the weight of the instrument.

This attachment is also useful in the determination of horizontal distances, it being obvious that the difference in rod reading between two complete revolutions of the screw will indicate at once the distance of the rod from the observer. Where the ground is level, or nearly so, the simple difference in rod reading will suffice; but when this is not the case, the necessary corrections will have to be applied to obtain the true horizontal distance.

7. The Spirit Levels

We have already noted that for our purposes we use the very best article obtainable.

An instrument of precision, capable of measuring delicate differences, requires delicate and sensitive levels. This is so obvious that we ought not to call attention to it here, were it not for the fact that we are frequently approached by engineers who wish to impress upon us the idea that this or that make of instrument met with their approval because its bubbles would stay in place when once adjusted. For this reason we want to repeat that it is no claim for superiority of a spirit level because it works sluggishly. An engineer in the field must know when his instrument is absolutely level, and its bubbles should indicate to him at once when this is not the case. If they do not do so, then

the instrument does not come up to the required standard of a precise tool. It would hardly do to place a carpenter's level on a transit, yet we have no doubt that its excellent qualities of remaining stationary would find admirers.

There is, of course, a limit to the degree of sensitiveness, and that we never exceed, adapting it in all cases to the work demanded of the particular instrument in hand.

Our levels are ground to the proper curvature, and each is carefully tested upon our *level tester* before it is attached anywhere.

The telescope can be fitted with reversible level if desired.

8. The Telescope

We have now reached another most essential feature of the instrument—that which may be compared to the head of the body, containing the delicate organ of sight—the lens.

The Lenses

We have already called attention to the fact that our optical accessories are the finest made and that we take great pains to obtain the best article for the purpose.

Without going into the detail of optical mathematics and formulæ, that can be readily found in any textbook on physics, we all know that it has been the constant aim to produce lenses as free from spherical and chromatic aberration as it is possible to make them. The lenses of the Lietz telescopes are an achievement in theoretical and practical science of which it would be interesting to make some explanation had we the space to give to it.

The optical powers of the telescope are in perfect keeping with the accuracy of the centers, graduation and spirit levels, insuring a complete reliability and harmony in every part of the instrument for the most refined surveying work.

The eye-piece (always erect unless specially ordered) is so arranged as to permit its easy removal, if necessary, by simply unscrewing it. In replacing, it should always be well tightened up. It is movable in and out by a revolving motion, turning the cap about one-sixth of a revolution backward or forward, comprising the most practical and efficient method.

We shall now describe in a few words the mechanical construction of its other parts.

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Other Parts of Telescope

The *slide*, to which the object is attached, fits directly in the outside or body of the tube. Particular attention is paid to this part to prevent even the slightest *shake*, and still procure an equal and sure motion, which is absolutely necessary, as no true adjustment of the line of collimation is possible otherwise. The motion is given by a spiral rack and pinion.

The sliding tube is protected from dust and dirt by an exterior metal cylinder, called the *slide protector*.

A *sun shade* is provided for the objective, which should always be attached, as the telescope, when focused to mean distance, is balanced with it; and a cap is provided for the protection of the objective when not in use.

The *cross-wire frame* is suspended in the tube by four capstan-headed screws, by which it is adjusted, the frame being so constructed that the cross-wires cannot be torn, in case the adjusting screws are tightened too much.

The *spider web* used for our instruments is properly treated to avoid all twist, and to prevent its lengthening and becoming crooked in damp weather; it cannot become loose, as it is well secured.

For mining and tunnel transits we can provide proper means for illuminating the cross-wires—an arrangement that is readily supplied upon application.

Stadia hairs are placed in our transits (and levels) when ordered. We have superior facilities for setting them with great precision to any desired ratio between distance and rod reading. It is customary to place them so that they shall read 1 foot on the rod for a distance of 100 feet, and to this measure we always have them in our stock on hand.

The stadia hairs may be *fixed* or *adjustable*. We advise the fixed, as they are less liable to change their distance. In an adjustable set the observer is never certain that the position of the wires has remained unchanged. We have constructed a delicate optical and mechanical apparatus for fixing stadia hairs accurately to any proportion; and by means of our powerful telescope, which has superior optical qualities, we can safely say that, with proper care and a little experience in that method of measuring, very satisfactory results may be obtained. The facilities for measuring across inaccessible places, and the speed with which it enables one to get distances, has brought this method into deserved prominence with our engineers. For topographical surveys it is indispensable.

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When purchasing a new instrument, it is advisable to get one that has fixed stadia wires, which increases the cost only slightly, while a greater charge is made to put them into a transit or level sent to us subsequently.

In sighting with the telescope it is of considerable advantage to have it *reversible*, and our transits are made so as to allow this free revolution in a vertical plane. The telescope balances accurately when in focus to mean distance, the friction in the bearings being shaded to such a degree of nicety that it shall neither work too hard nor too loose—a feature which ought to have very close attention.

General Remarks About Telescopes

When selecting or examining an instrument, the engineer should be particularly careful to test the qualities of the telescope.

It should have sufficient magnifying power to correspond with the finer qualities of the graduation, axis, centers, spirit levels, etc., of the instrument. There can be no doubt that the excellencies of each detail must compare with that of any other.

Now, by using a low-power telescope, the *defects of an inferior instrument may be hidden, or left undiscoverable*. We lay the greatest importance upon these facts, and for this reason call particular attention to them.

We have found that the power of first-class instruments should be about twice as many diameters as the length of telescope expressed in inches.

In another place we have added a practical method for finding the magnifying power of a telescope.

We have already pointed out the importance of perfectly centering the lenses, especially the objective. If this is not properly attended to, the adjustment can never be perfected for long and short distances.

We have heard many complaints of various makes about the change in adjustment, and after careful examination we have found that the adjustments remained intact, but that the fault lay in the objective, which had not been correctly centered. We take great pains to center our object glasses perfectly, and to insert the lenses in such a manner that if taken out they may be replaced in the old position. It is not advisable for engineers, however, to take these lenses from the cell, as their cleaning may be effected without removing them.

Reverting again to the magnifying power of telescopes, it may be asserted that an increase thereof reduces the field. This is no defect,

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if the size of the latter is retained large enough to admit of stadia lines so placed as to read 1:100. We often leave the field much larger, however, in which case there appears just a slight dimness at the extreme border; this is unimportant, for it does not detract any of the virtues of the glass, and possesses, if anything, an advantage of finding an object more readily.

The quality of some of the telescopes of our best makers has often been questioned by competent engineers on account of a peculiar haze ascribed to the glass. This was found to be caused by a small film of moisture, which settles between the crown and the flint, and is not visible to the naked eye. We have been convinced, by advising with our optician, that the crown and flint glasses should always be connected with balsam. This does not decrease the amount of light, as formerly thought, but, on the contrary, it has advantages of clearness, in that it prevents foreign matter from settling between the lenses, which always destroys the image; the refrangibility, too, is under more favorable conditions in the balsam.

Securing Stability of Adjustments

This is accomplished by having properly alloyed metals, which are treated by a heating process before the finer fitting is done—thus removing all strain. We have also special collimating apparatus whereby we test the completed instrument under various temperature changes in regard to stability of adjustments.

Extra Accessories for the Transit

There are a number of additions made for transits used for special purposes, and these we keep on hand, and supply them when called for.

In fact, any of the accessories, not usual in the ordinary complete field instrument, will be made as an extra if our patrons will notify us.

For the *solar attachment* and side telescope necessary fittings are provided. Complete descriptions of these attachments will be found on pages 90 to 93.

The Finish

The various parts of Lietz instruments are finished with preparations which have been developed to reduce the coefficient of expansion and contraction to a minimum and at the same time add to their neat appearance.

Size of Transit

The dimensions and proportions of the several parts of the transit are given in Part II of this catalogue, where the different sizes and varieties of instruments made are described more in detail.

Packing

This is not at all an unimportant feature. Our transit is easily taken from the tripod and set upon a wooden slide. Nothing is taken from the instrument except the shade—it remains a complete whole from the base-plate to the top of the telescope. The board slides into the box with the transit in an upright position, with the clamps secured to keep it from turning. The door may then be locked, and the instrument is absolutely safe, with the least effort of packing and adjusting in the box.

Rubber cushions are provided at the bottom of the case, to take up any sudden jar or jolt to which it may be exposed during transportation.

The Tripod

We have adopted the new form of *split leg*—a construction which combines the greatest stiffness and strength with the least weight.

The very best white ash is chosen and carefully worked. Instead of fitting the leg between two brass cheeks, we fit one cheek in the leg. In the older construction it frequently happened, in drawing the bolts closer to tighten a loose leg, that the cheeks would spring the plate, or weaken the screws that hold it. This is entirely obviated by the new arrangement of these parts, for the tightening can no longer affect the plate in the least. While in the former the leg would only fit at the lower part of the cheeks when drawn in by the bolt, it will always fit the whole surface of the cheek in the plan we follow, and after ten years' use it will be just as steady as when new.

The *shoes* are made on a gradual taper to a sharp point, and securely fastened to the leg. They are provided with a projection for pressing upon with the foot when setting up.

The large transit and the level fit the same tripod. The base plates and tripod heads of Lietz Instruments are of a diameter which insures extra stability in the set-up. The design of the tripod head secures protection by a circumferential ring against damage caused by rough handling.

The desire for greater stability in the set-up has induced us to adopt a larger and heavier tripod for the Lietz 6 $\frac{1}{4}$ " transit and 18" Wye and Dumpy Levels than what is generally used with instruments of other makes and similar size.

We are, however, prepared to furnish upon application the lighter weight tripods as heretofore, the weight of which is about 9 pounds.

LEVELING INSTRUMENTS

Lietz levels are manufactured in two different types, which we aim to keep constantly in stock, the *Y-level* and the *Dumpy level*.

In the manner of making these instruments, much that has been said of the transit will hold good here, and need not be repeated.

The three main qualities to be secured in a level are: *stability*, a *sensitive bubble* and a *powerful telescope*.

To secure the first, we need only refer to the solid construction of the star-shaped casting through which the leveling screws operate, already described in speaking of that feature in the transit.

The *center*, or spindle, is long, and is continued through the clamp up to the bar, which enables us to bring the center of gravity as near as possible to the tripod head. Great care is exercised in fitting the center to the socket, and, being made of the hardest composition, it must be apparent that it is an utter impossibility to wear out these parts, even by years of constant use. The liability of bending the spindle, so common an accident with instruments having soft centers, and the fretting of the same, also likely to happen at times, is altogether avoided.

The reasons for having a *sensitive bubble* have also been carefully set forth heretofore. Accurate work cannot be done with a sluggish bubble. No matter how much the virtues of the staying qualities may be extolled, they are not fit for refined work if they do not answer the slightest touch of the leveling screw. If you can give a screw a twist or two before the bubble loses its peaceful equanimity, the work in hand would not be likely to inspire any great confidence.

A refined level of this character, however, will only do good service in an instrument having perfect steadiness and a powerful and sharply defining telescope. If placed in a level so constructed as to be top-heavy, or in one whose center is frequently exposed by being a part of the tripod head—and therefore liable to collect dust both on the cone and in the socket, introducing sources of error after every detachment—then it will indeed prove very annoying, should an active bubble accompany such an instrument. These structural defects are probably the cause why many of our engineers are prejudiced against sensitive levels, and prefer a sluggish or dull one. We can only assure the reader again that a lively bubble, even if a little out of center by

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reversing the instrument, will still accomplish better results than an inactive one—one that gives the instrument an appearance of steadiness, which in reality it is far from possessing. An engineer only deceives himself if he trusts to a slowly acting level, which gives apparent satisfaction by concealing the errors that a sensitive one would soon indicate. A precision instrument never suffers by having its qualities exposed by a high-grade bubble.

The level telescope should have power and definition. It is hardly necessary to make that statement, after all that has been said on this subject in a previous chapter. It has been our earnest endeavor to obtain these results, without increasing the dimensions of the telescope and the other parts of the instrument beyond the proper limits for steadiness and portability. A length of eighteen inches we have found to give the most advantageous results. Experience has shown us, that although an increased length adds to the magnifying power, it would only be of value if the other parts of the instrument were enlarged in proportion, which, on the other hand, would make it too heavy for convenience in carrying and offer more surface to the wind, thereby reducing steadiness. We believe that with our 18-inch level even the most extensive requirements in engineering are fully met.

Our new and improved eye-piece, and the use of an objective of proper proportioned diameter, enable us to obtain a magnifying power of 33. An increase of diameter adds very little to the weight of the telescope, and does not require a longer bar and larger plates, as an increase in length necessarily would, to retain steadiness. An aperture of $1\frac{3}{8}$ inches, used to its full value, affords a high illumination with the above-mentioned power, as the tube is large enough to let all the rays proceeding from the object glass pass through to the field of view.

The diameter of the aperture of the object glass divided by the power, gives the diameter of the pencil of light entering the eye. In our telescope we obtain, therefore, $1\frac{3}{8} \div 33 = \frac{1}{24}$ of an inch, which shows that power and brightness are in accordance with optical law. To force the power beyond these limits we cannot conscientiously do, as that would be allowable only under certain circumstances—such as a perfectly clear atmosphere with a strong illumination of the object.

The *collars*, upon which the telescope rests in the Ys, are made of the hardest bell metal, and admit of a position in either direction, that is, the telescope is reversible. The very first requisite is that these collars must be of exactly *equal diameter* and *perfect cylinders*. If this

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be not the case, the line of collimation will not be parallel to a tangent of the bubble's curve at its highest point, when the latter indicates a horizontal position, and, for this reason, a true level cannot be obtained with such an instrument.

It is very often believed that in the course of adjusting the Y-level, by reversal of telescope and revolving on center, the bubble will indicate any inequality of the collars, but this is by no means true. If the Ys are both filed out to the same angle (this is generally the case, or at least very nearly so, as most makers file them out by means of gauges), the *inequality* of the collars may be quite appreciable, and yet the instrument will be adjustable in all its parts; in other words, it may be so adjusted that the bubble on all reversals in the Ys and revolutions on center will always give the same reading at both ends, that is, indicate a true horizontal position. A final test is necessary, therefore, after the instrument is properly adjusted, to ascertain the equality of the collars. This will be mentioned further on under the head of adjustments.

Similar causes for error are introduced if a particle of sand lodges between the collar and Y, which illustrates the necessity of keeping these parts free from all dust and dirt.

It is readily demonstrated to what considerable difference any slight inequality in the diameters of the collars may give rise to, but the space here will not permit of a mathematical discussion of the subject.

We have carefully explained this defect, owing to the conviction on our part that it is a much more common one than is generally suspected. Numerous cases have come under our observation where this fault existed in a remarkable degree. And in the perusal of many works on engineering and surveying, we have noticed very few that call attention to this material defect, and still less that give a correct test for it.

We are aware that accurate leveling may be done with a level out of adjustment, if the utmost precaution is taken to have equi-distant fore- and back-sight. But looking at it from this point of view, why not use the dumpy level then, instead of the more costly Y-level?

The Torchon Finish is made to give the instrument an elegant appearance, and yet obtain all the qualities alluded to in a previous discussion of the same subject.

The level telescope is supplied with a *slide protector* and with a

sunshade; the latter should always be put on to balance it evenly. A cap is also provided for the objective and a shutter for the eye-lens.

In all other matters the transit details obtain here also.

Fixed stadia wires can be supplied, set to read 1:100, for which an extra charge is made if ordered, unless included in price stated.

The center movement is checked and regulated by a *clamp* and *tangent screw*, exactly similar to those of the transit.

Other useful accessories are attached, but any feature not usually found in the Y-level must be ordered beforehand.

We are likewise in a position to make, but upon order only, *levels of precision* for the most exact work that the geodetic surveyor is called upon to perform. These are provided with all the delicate details that such an instrument must possess. We invite correspondence upon the subject of geodetic instruments, and will cheerfully furnish prices after consulting with our patron upon the nature and character of the instrument required.

The *packing* in the case has been made so as to assure safety in transportation, with the least trouble and inconvenience to the operator. The level is taken from the tripod and is let down to stand upright in the box, when the closing of the lid holds everything firmly in place. In all minor details the level box is similar to the transit case, every means being employed to insure absolute safety.

The Dumpy Level

In this instrument the aim has been to construct it in such a manner that it shall be as compact as possible by dispensing with certain features of the Y-level not absolutely necessary in order to do good and reliable work.

The principles governing its construction are the same as those that obtain in the more elaborate Y-instrument.

The telescope is permanently held by two vertical arms attached to the level bar, and cannot be taken therefrom. The level tube rests upon these arms, over the telescope, and is also fixed. The telescope tube is thereby brought as close as possible to the tripod head, which is a desirable characteristic. All the other features remain the same as in the Y-level construction.

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This instrument, which is almost exclusively used in Europe, has not yet met with that favor by American engineers which its simplicity and accuracy so justly deserves. This is due partly to its greater inconvenience in adjusting as compared with the Y-level, and partly on account of defective construction, inferior telescope and other neglected details, which usually obtain in instruments of this kind.

We are confident that a dumpy level possessing a good telescope, sensitive bubble and stability, will do *just as good* work as the more costly Y-level. While the adjustment of the latter is made more readily, the former will *retain* it longer.

Our dumpy level has a bronze center, an 18-inch telescope, and a sensitive level vial.

There is no clamp or tangent screw to this form unless ordered by the customer.

The stadia hairs may also be supplied to the dumpy level.

Other Levels on Sale

In addition to the high grade instruments described, we also keep on hand a supply of smaller and less costly goods for leveling. With these instruments work may be done by the ditcher, irrigator, contractor, grader, farmer, dike-builder, gardener, plumber, architect, forester and military man, sufficiently precise for many ordinary purposes, wherein great accuracy is not required.

For a more detailed description of these instruments, see Part II of this catalogue, containing a price list of articles on sale.

Alidades and Plane Table Outfits

We manufacture various sizes of topographers' alidades and Plane Table Outfits. Complete description and specifications will be found in Part II of this catalogue. See pages 108 to 119.

REMARKS

In the foregoing we have endeavored to give the reader a fair idea of the principal engineering instruments made by this firm. We desire to convince our future customers—our old patrons we have long since convinced—that we are building conscientiously upon scientific principles, that every part and detail has been carefully studied to meet the requirements of our engineering fraternity, of the climate, and of all those conditions that influence the shape and character of every feature of the surveying instrument. It must permit of all operations at the least expenditure of time, it must be compact, it must be light, it must be absolutely accurate, it must be rigid, it must be stable and it must possess strength. And wherever a possible improvement is suggested in any detail, it must be applied at once and tested as to its probable merits, and if it prove of value, no time must be lost in introducing it. These are the principles that have governed the manufacture of the articles which we have brought to your notice.

Improvements have always had our attention, without any regard of the expenses incurred in experimenting.

With the object constantly in view to make only the very best article that can be produced, and ever ready to introduce improvements and to experiment with suggestions that may lead to them, our instruments are held at a price that is commensurate with their qualities. Their values are rated by those current among first-class instrument makers; they are *no more*, but they are *no less*. We do not handle cheap goods, and the trade that we are most anxious to please is that *willing to pay a fair price for a number-one article*.

It was our purpose to describe in this catalogue only the instruments for which there exists the greatest demand, and for this reason we do not intend, at this time, to enter into any detail of the manufacture of other scientific apparatus that we are in position to furnish upon due notice.

Theodolites of the highest grade for the most exact purpose, reading with micrometers to the most refined division, are made upon order to any desired shape and design, and with every required accessory.

CARE OF INSTRUMENTS

The greatest source of danger to a delicate instrument is *careless handling*. It is often subjected to violent usages for which there is absolutely no need. The rude way of manipulating its delicate parts; the unnecessary display of digital strength in operating a clamp; the

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useless strain applied to the leveling screws; the careless manner of carrying it; the rough method of taking it out of its case, or replacing it; and the incautious closing of a lid or door of a box by force, before the instrument is somewhat adjusted to its position; all these are sources of danger that vitiate its adjustments and cause no end of trouble and expense. Although a well-made instrument is so designed as to stand many a shock without direct injury, any daily repeated abuse is sure to have its ill effect, from which your work must suffer.

As the usefulness of a transit or level may be preserved for many years by a little attention to details, we shall enumerate a few of the principal points which the engineer will do well to observe.

Always protect your instrument from rain by throwing over it a waterproof bag; and if it gets wet at all, clean it thoroughly after getting under shelter. It is not well to enter a hot room from the cold air, without giving it some protection. The condensing vapor settling on the metal and glasses is certain to give rise to injuries. It is always safe to place the instrument in its case before going into a warm room in winter. It is not well to leave your transit or level exposed for hours to the hot sun. Shade must be given either by a hood thrown over the instrument, or by an umbrella.

But accidents are liable to happen, and for that reason we have noted down a few remedies in case of an emergency.

The general tendency in the use of the screws is to overstrain them. This should never be done, especially with the cross-wire screws, which, when brought up too tight, are liable to constant change and loss of adjustment. The leveling and clamp screws, if overstrained, wear out sooner and may show fretting. If this takes place, they should be taken out and brushed with a little coal oil or benzine. The nuts are best cleaned by screwing a flat piece of soft wood through their apertures. In putting them together oil them slightly.

Fretting of the centers and of the telescope-slide will interfere more with a correct working of the instrument than any other part out of order. They should be watched, therefore, very closely, and as soon as any rough motion manifests itself, it should be remedied at once, if possible, by an instrument maker. If this cannot be had, and the fretting is in the slide, first scrape and then burnish down the place where it frets. It may also be ground slightly with oil and very fine pumice stone dust, which is best obtained by rubbing two pieces on each other. After grinding them a little, the tubes should be cleaned and placed together again with oil only; then move them in and out

a number of times, wipe the oil off, and finally put them together when dry. Should the fretting occur in the centers (if properly made and constructed, so that they do not come apart in detaching the instrument from the tripod, this will never happen), employ the same means; and if this be not effective, place a washer, made of paper or a thin card, between the shoulders. This will cause a shake, making accuracy impossible, and will introduce errors of parallax in reading off, which is better, however, than to destroy the centers wholly. The best unguent for them is a very fine watch oil. Regarding *our centers*, we are fully prepared to assure our customers that *no fretting will ever happen*, as they are never exposed, and made with the utmost care.

The object-slide should not be oiled. Never, under any condition, use emery in trying to repair an instrument, as it cannot be removed again and will grind continually.

An efficient lubricant for leveling screws, clamps, pinions, etc., is well-rendered marrow.

If an instrument is upset, thereby bending centers and plates, do not turn it unnecessarily, as this will disfigure the graduation, but send it to a competent instrument maker immediately. There should be no delay in repairing defects.

In the matter of the tripod, it is wise to look to the screws that hold the legs frequently, and to keep them well tightened up; and to inspect the shoes, to see that they do not come loose. An instrument cannot be steady if there is any shake in the tripod, which is its support and must be firm in every particular.

The graduation is a very delicate detail to handle, and should be approached only with the utmost care. It is safe to leave this part to the instrument maker, and not to attempt to remove the plates, as they cannot be properly recentered without the aid of a testing apparatus. An exposed graduation may be cleaned with a little watch oil applied with the bare finger, taking care not to touch the edges while this is done.

To preserve the sensitiveness of the *needle*, the center pin must be prevented from becoming dull. The instrument should never be lifted without raising and arresting the needle, and if, upon letting it down again, the swing is too large, gently stop it when within a few degrees of its natural bearing. Every check and start must be made gently, never abruptly. Should the point become dull, it is best to send it to an instrument maker; if this be not practicable, a watchmaker may perhaps attend to it. It should be remembered, however,

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that the point of poise must be centered—that is, occupy the center of the graduated circle. This cannot be done by a watchmaker, and is only to be relied upon if made in an instrument maker's shop.

If a needle is made of good steel, well hardened and properly charged, it will not often lose its magnetism; and if, when placed away, it is always brought to line in the meridian, it will retain, or even increase its polarity. If a needle has lost its magnetism it may be charged again with an ordinary horseshoe magnet; one of three inches in length will be suitable for this purpose. The operation is this: hold the magnet with the poles upward, then, with a gentle pressure, pass each pole of the needle from center to extremity over the opposite pole of the magnet, describing before each pass a circle with a diameter of about double the length of the needle, taking care not to return it in a path near the pole. If the magnet is strong enough, the needle need not be taken out at all, but by raising it against the glass and then passing the magnet over this, it will be charged sufficiently. After charging, the needle has lost its balance, which may be easily restored by shifting the balance wire on the south end.

The observer should always satisfy himself that there be nothing about his clothing, especially in the make of the buttons, that would have any influence upon the needle.

In the matter of the telescope, intelligent handling will do much towards preserving its accuracy and reliability for a long time. In cleaning any of the lenses, use a soft rag or chamois leather. If the glasses should become greasy, or very dirty, wash them with alcohol. The inner faces will seldom require cleaning, and it is not advisable to take the telescope apart too often, as it is likely to destroy its adjustment. If dust should settle on the cross-hairs, it is safest not to touch them. The only remedy that may be tried is to take out both the object-glass and the eye-piece, and to blow gently through the tube. This may remove the dust without injuring the threads, but it is quite a delicate operation.

Cross-hairs may be replaced in the field by the engineer. The spider web is cleansed from dirt by placing it in water for a few minutes. A little manipulation readily removes any particle that may adhere to the thread. After drying for a moment, adjust it to the diaphragm, previously cleaned from dust, and attach it by means of a little shéllac. It requires considerable practice to do this nicely, for a spider's web, although quite strong, cannot be handled by clumsy

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fingers without parting; but in the case of an emergency the engineer must try to do the best under all circumstances.

Referring again to the lenses, it is well to remember that in taking them apart, the centering is disturbed, and the engineer is not able to replace them properly, especially if they fit loosely in the cell, which is very often the case. The staining of flint-glass lenses is caused by the corrosion of the oxide of lead contained in the glass. This will generally occur when the lens is kept in a damp place for some time. In cleaning an object-glass, care should be taken not to rub it any more than necessary. Brush off the dust first with a camel-hair brush, and then wipe it carefully with a clean piece of chamois leather. If very dirty, wash it with alcohol or water and soft chalk, being careful to have the latter free from grit.

Considering that, in cleaning, each rub will destroy more or less of the fine finish of the lens, upon which depends the brightness and brilliancy of the image, the surveyor will be well repaid for his care in this particular.

Similar attention must be bestowed upon the *eye-piece*. With our high power eye-pieces, a motion of only three-sixteenths of an inch is necessary to allow for difference in eyes. As the sliding motion is for this purpose alone, it is not at all necessary to disturb it after it has once been properly adjusted, as long as *the same* person is using the instrument; even in packing it away in the case the eye-piece may be left so, as this extra extension is allowed for in the box. The cap is provided with a slide to protect the eye-lens from dust while the instrument is not in use; the engineer should never neglect to close this, and to cover the object-glass with its cap as well, as soon as the instrument is set at rest.

Repairs*

We are fully prepared to make careful repairs to all instruments, from the graduation of an arc or circle, and the straightening of a center or plate, to the setting of a simple screw. In this particular branch we have operated here for the last thirty-odd years, and have gained the fullest confidence of our people. We need only state here that we guarantee satisfaction to our customers in every way.

As we are located in California, separated by the breadth of the continent from our Eastern colleagues, we are necessarily required to

*Experience has taught us that it is not wise to allow an ordinary mechanic to attempt instrumental repairs, as frequently resorted to in inland towns. It is always the case that this proves ruinous to the instrument, and subsequent repairs will be more extensive and expensive than if it had been shipped to the instrument maker at once. Express charges are of far less importance, and may be made very reasonable. See notice in front of this manual.

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repair instruments of almost every known make, and this has compelled us to procure the various requisites in the workshop for all emergencies. Today we are in the position to renew any part of an instrument, no matter where it was originally manufactured. Time and money will be saved by sending directly to us, and we shall try to give our customers every satisfaction. Whatever is entrusted to us will be thoroughly overhauled and put in the best possible condition, unless specified orders are received to confine the repairs to certain details. As a general thing it ought to be left to our judgment as to what the instrument requires; it may cost a little more if you follow our advice in this particular, but it will certainly be more satisfactory in the end. It will save time, trouble and additional expense. In the course of our examination of an instrument needing repairs, we discover defects that could not be apparent to any one before its parts were separated and individually tested. What may appear of no consequence, and is therefore neglected, is quite likely to lead to all sorts of subsequent inaccuracies in your work. Years of experience in this particular line have taught us the advisability of urging this point upon our patrons.

Transits and levels should always be accompanied by the leveling plates; the tripod and head need not be sent. With compasses the ball spindle should be sent.

We advise our customers to pack their instruments carefully, when sending them to us for repairs, as they are liable to material injury if this precaution be neglected. The space in the box between the different parts—of the transit particularly—may be filled with soft paper wads to protect it from jars and blows. It is well to put the case in an additional box, a little larger in dimensions, in such a manner that the top of the case is plainly visible and its leather strap handy for carrying. The space between the case and the box may be padded with shavings, or some soft material to take up the shocks. Mark upon the top of the box in large, legible letters:

.....
:  THIS SIDE UP ! ! :
: SCIENTIFIC INSTRUMENT, :
: Handle With Care ! ! :
.....

And ship through a responsible express company, plainly addressed to:

THE A. LIETZ CO.,
632 COMMERCIAL STREET,
San Francisco, Cal.

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The name of the *sender* and *his address*, together with the *value of the instrument*, should also appear on the box.

This will insure comparative safety in transportation, which is a point that should be well observed by the engineer. And this precaution would also increase the responsibility of the carrier, in case the instrument had suffered during transportation.

When an instrument is sent to us for repairs, a letter or postal card should be mailed at the same time, to inform us of the fact, giving the necessary directions, and stating when the return is required. The receipt of the instrument will be acknowledged by us at once.

Kindly address all correspondence to salesroom, 61 Post Street.

ADJUSTMENTS

Adjusting an instrument consists in delicately moving to the right or left, and up or down, certain parts that must be either parallel or at right-angles to each other. This is done by slightly turning a number of capstan-headed screws or nuts by means of a small steel rod, called an adjusting pin. Adjusting the vernier and compass consists in placing certain points in a straight line; but as these corrections are always made by the instrument maker, they do not properly apply to the subject before us. Verniers, limb and needle, if properly placed at the outstart, will not need any correction in the ordinary use.

The adjustments of Lietz instruments have been made and verified with the aid of collimators, which excludes uncertain atmospheric conditions and other elements; these often cause apparent changes of adjustments when tried in the field, where abnormal conditions generally exist, and which must be duly considered to avoid unnecessary delay and annoyance.

The permanency of adjustments in Lietz instruments is such that they will not need attention, except when accidents occur or after years of use, when slight wear may affect them.

Of the Transit

1. ADJUSTMENT FOR PARALLAX.—This consists in so focusing the eye-piece that the cross-hairs shall stand out distinctly and well-defined, when the telescope is directed upon an object in focus. If this is not properly done the hairs will be dim; they will appear to travel and to seem unsteady when set on a mark. We know that this has given considerable vexation to the observer, and instruments have been dis-

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paragingly condemned for their apparent parallax, when nothing more was necessary than a slight movement of the eye-tube to focus the hairs properly. This fact should be well borne in mind. Our eye-pieces are quite easily moved in or out by a revolving motion, which affords a very fine and precise adjustment to focus.

Operation.—Direct the telescope so as to have a clear view of the sky, and then turn the eye-tube by the cap as just described, until the cross-hairs stand out like two sharp and distinctly drawn black lines. After a few trials this is accomplished without difficulty. Then try the telescope upon some object brought into focus and test the clearness of the wires. A point now bisected must stay so while the eye is moved laterally in front of the eye-hole. If it remains stationary, there is no parallax and the adjustment is made. Once properly set, the eye-piece may remain for the same observer for all time, and need not be adjusted from day to day. Attention has already been called to this point in a previous chapter, where it was noted that the instrument box was made large enough to allow the eye-piece to extend beyond the tube. (The sun-shade should be put on the telescope first, and then focused to mean distance to balance it properly.)

2. PLATE LEVELS.—The object is to set the levels at right-angles to the vertical axis of the instrument, so that when the bubbles are centered the axis is truly vertical.

Operation.—Bring the bubbles to the middle of the tube by means of the leveling screws, then turn the instrument on its center 180 degrees. If they remain central for any position, they are in adjustment; if not, they must be elevated or depressed at one end to correct them. One-half of the required correction is made with the capstan-headed screws on the vial case, the rest by the leveling screws of the instrument. Several repetitions of the operation may be required before attaining accuracy. It is well to have the plate in such a position that the levels shall be parallel to a pair of opposing foot screws. If they are out considerably, it is better to adjust one first, approximately, and then the other.

3. THE STANDARD BEARINGS.—The telescope should revolve in a vertical plane when the instrument is level. One end of the telescope axis must be either raised or lowered until accuracy is reached. A capstan-headed screw is attached for that purpose.

Operation.—Set the instrument up within about fifty feet of the wall of a house. Take a well-defined point as high up as possible on

the wall; clamp and bisect; then turn down the telescope and put a point in line as low on the wall as may be conveniently reached. Reverse the telescope and direct again to the upper mark, if you please; clamp and bisect; turn down to the lower mark, and if it is bisected, the telescope revolves in a vertical plane and requires no adjustment. If it does not strike the point absolutely, one-half of the difference is taken up by the capstan-headed screw, and the adjustment is done. Several repetitions of the operation may be required. It is not necessary to level the instrument, but it should be brought in such a position as to admit the bisecting of two well-defined points. Care should be taken, however, that the observation is made at the intersection of the cross-wires, and that the instrument is securely clamped.

This adjustment should always be made before that of the cross wires, for this reason: that unless points of equal height are taken in the subsequent adjustment of the vertical hair, it will only then prove correct, if the telescope revolves in a truly vertical plane. It is therefore always better to look to this before the cross-hairs are adjusted.

This adjustment may also be made by means of an accurate striding level, such as manufactured by this Company for use in high-grade instruments. The transit must be precisely leveled up by the foot-screws and plate bubbles, after which the striding level is placed across the telescope, resting upon its axis. It is evident that the bubble will indicate any deficiency in the horizontal parallelism of this axis, and, therefore, any error in the true vertical motion of the telescope, which may be corrected until the bubble of the striding level remains centered.

4. THE CROSS-WIRES.—The line of collimation should be at right-angles to the axis upon which the telescope revolves.

Assuming that all the required conditions have been fulfilled by the instrument maker—having placed the telescope in the center of the instrument, and having the tubes perfectly straight and normal to the telescope axis, which are necessary instrumental requirements, there are two methods that may be employed. One is by means of back and fore-sights, which is that generally used; the other consists of a test by means of three points in a range, where the middle one is occupied. Preceding either method the hair should be made truly vertical, so that either the upper or lower end will bisect a point when the telescope is moved up and down. This is easily done by loosening the diaphragm and turning it slightly in the required direction. To accomplish this the instrument must be leveled up.

Operation, First Method.—Occupying a point, direct the telescope

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to some well-defined mark, about four hundred or five hundred feet distant; clamp and bisect it; then revolve the telescope and place a point in the opposite direction at about the same distance. Now unclamp and turn the instrument half-way around; set the hair again on the first point, revolve the telescope and sight to the second point. If the intersection bisects the latter, the vertical hair is in adjustment. If not, the error can be corrected by the capstan-headed screws, which afford a lateral motion of the diaphragm. With them the vertical thread should be moved one-fourth of the space intercepted between the direction of the telescope and the direction of the second point. Several repetitions may be necessary to obtain accuracy.

The reason why only one-fourth of the space should be corrected for, becomes evident from the fact that in the first revolution of the telescope the error of the hair is doubled; and after reversing the instrument and revolving the second time, it is again doubled, but on the opposite side, so that the true direction lies exactly half way between the two, and to correct for it we must move the hair one-half the space between the true line and one of the points.

It is not necessary to level the instrument in order to make this adjustment; but in case it is not leveled up, the observations must be made exactly at the intersection of the cross-wires.

It must be remembered that the image at the cross-hairs is inverted, and that in consequence the screws must be moved in apparently wrong directions.

If there is any lost motion in the tangent screw, great care should be exercised in handling the telescope, so as not to influence its alignment.

Operation, Second Method.—Locate with the telescope three points in one direction, which are necessarily in a straight line, as long as the vertical movement of the telescope is in adjustment. Occupy the middle point with precision, and bisect one of the end points; revolve the telescope and sight at the other end point. If this is bisected, the instrument is in adjustment; if not, correct for it by taking up one-half the error. This method requires leveling of the instrument.

Thus far we have been speaking of the vertical hair only, as it is the more important in a transit telescope. In a plain transit—that is, one without a telescope level and without a vertical arc—the horizontal thread simply serves to define the middle of the vertical one, so that the observation may always be confined to a particular *point* in the latter. But if a level is attached to the telescope, then the horizontal hair should be brought into the optical axis, before the level is set

parallel to the line of collimation; otherwise, though adjusted for long distances, it will fail to be correct for short sights.

Operation.—Set up the instrument near a house or fence and level up carefully. Clamp the telescope, and by means of its tangent screw bisect a point several hundred feet distant; then turn on center and mark a point on the house or fence, about ten feet distant. Now unclamp telescope, reverse it, revolve on center, and again bisect the nearest point. Turn instrument on center and see whether the hair intersects the further point. If it does not, the correction must be made, by lifting or lowering the diaphragm by means of the upper and lower capstan-headed screws, until the bisections, after repeated trials, will coincide.

5. THE TELESCOPE LEVEL.—The object of this adjustment is to make the level parallel with the line of collimation. The principle underlying the method is: that points taken with the same angle of elevation or depression, and equally distant from the instrument, are of equal height.

Operation.—Set up on a nearly flat surface and level carefully. On opposite sides, at *equal* distances, drive two stakes giving the *same* level-rod reading, with the telescope bubble centered in each instance. These points are necessarily on a level with each other. Now move the instrument to a point in line with both, and about ten feet distant from one. Level up again. Take a rod reading on the nearer and then on the further stake. If they agree, the level is in adjustment; if not, move the telescope with its tangent screw over nearly the whole error, and sight again at the nearer stake and then at the further, repeating this until the readings are the same on both, when the telescope is truly horizontal. Now bring the bubble in the center of the tube by the correcting screws of the level, and the adjustment is completed.

This adjustment may also be made in a room with the aid of a surveyor's level, with absolute accuracy.

Operation.—A few feet (one or more) from each other set up the transit and level, each directed to the other. The cross-hairs of the level must be illuminated by a light, so that they shall become plainly and clearly visible through the transit. For this purpose cover the eye-end of the level with a bit of white paper and place a lamp behind it. Focusing both instruments properly will make the hairs appear very distinctly. Now, if both instruments are properly collimated, the level carefully leveled up, and the transit telescope of such height that we may view the interior of the level's tube, we are ready

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to adjust the transit telescope to a level plane, which is done by simply placing the intersection of its cross-hairs delicately over the intersection of the level's cross-hairs. All that is required after that is to center the transit's level bubble by means of the proper adjusting screws.

This method recommends itself on account of its extreme simplicity.

6. ZERO OF VERTICAL ARC.—This adjustment, once made by the instrument maker, is seldom vitiated. The object is to have the zero line of the circle agree with the zero mark of its vernier, when the level of the telescope indicates a horizontal position, and when the centers of the instrument are truly vertical.

Operation.—The instrument must be carefully leveled by the small plate bubbles, and then the telescope by means of its level. This accurately accomplished, the vernier is shifted until the zero lines coincide. This must be carefully done, so that the instrument is not disturbed, and, when the vernier is fastened, care must be taken to allow a space that shall neither be too small nor too great between it and the vertical circle. In the first case it would bind under certain conditions of temperature, and in the latter the observer would not be able to obtain an accurate reading. The coincidence of the zero-lines must be made with a magnifying glass, and all parallax avoided.

7. CENTERING THE FIELD OF VIEW.—There will be found another set of four slotted screws, diagonally to that which regulates the cross-hair diaphragm, and placed in a position quite close to it. These screws are for the purpose of directing the tube of the eye-piece in such a manner that the field of view may be divided by the cross-wires into four uniform quadrants; that is, they enable the operator to so adjust his field that it may be bisected horizontally and vertically by the threads.

Of the Y-Level

There are three principal adjustments. The spirit level must be parallel to the axis of collimation; it must be at right-angles to the vertical axis of the instrument; the axis of collimation must agree with the optical axis.

There are other instrumental requirements which belong to the instrument maker, however, and it is with the above three adjustments only that the engineer has to deal.

Before examining the adjustments, the sun-shade should be placed on the telescope, as it is only accurately in balance with this.

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1ST ADJUSTMENT.—To set the spirit level parallel to the line of collimation, and, at the same time, place its axis in a plane with that of the telescope. It is best to attend to the latter first.

Operation.—Turn the telescope so as to stand over two opposing foot-screws, clamp the instrument and bring the bubble to the center of the tube; then rotate the telescope in its Ys, so as to put the level considerably out of a vertical—say about 15 or 20 degrees. If the bubble changes its position, it shows that the axis is not in a plane with that of the telescope. Correct it by moving the two side screws of the level case, until one-half of the deviation has been taken up. A few repetitions will insure accuracy, and destroy the side motion of the level.

The level must now be made parallel with the line of the bottom of the collars.

Operation.—Bring the bubble to the center of the tube; then reverse the telescope in the Ys end for end; do this carefully. The displacement of the bubble, if there be any, is the double error, which is corrected by taking up one-half of it by means of the adjusting nuts on the level case, and the other half with the leveling screws of the instrument. This operation is repeated until the bubble remains in the center.

To accomplish a proper adjustment of the level to the line of collimation, it becomes absolutely necessary that the collars be of equal diameter. We have already referred to the importance of even collar dimensions, and have laid great weight upon this requisite; and here again we shall point out the errors to which a neglect therein may lead. A Y-level in such an event is not any better than a dumpy, and will have to be adjusted as such.

Providing the Ys are milled out to the same absolute angle, the instrument may still be adjustable in all its parts:—the spirit level may be made parallel to the line of the bottom of the collars; the Ys may be so adjusted that the bubble will remain in the center of the tube; the line of collimation may be brought to the center of revolution of the telescope; and this reversed end for end in the Ys, leaving the bubble in the middle, even if there be some difference in the diameter of the collars. It is the general opinion that after level, Ys and cross-wires are adjusted, the instrument must be correct. This is by no means certain, as the least difference in the size of the collars will throw out the line of collimation considerably. This difference is sometimes found in new instruments, and is also produced by unequal wear, denting, etc. It is therefore advisable that the equality of the

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collars should be tested from time to time, which is done by a method given further on.

2D ADJUSTMENT.—To place the level at right-angles to the vertical axis of the instrument.

Operation.—Turn the instrument so that the telescope shall stand over the line of two opposing leveling screws, and bring the bubble to the center of the tube; then turn the instrument 180 degrees on its center. If the bubble shows any displacement, correct one-half of it by means of the nuts under the bar at the Y supports, and one-half by the foot-screws. Several trials will make the correction perfect.

3D ADJUSTMENT.—To place the cross-web in the optical axis of the telescope, so that the intersection will remain on an object in revolving it.

Operation.—Set the intersection of the hairs on a point about two hundred or three hundred feet distant, then revolve the telescope in its Ys half-way, so as to have the level case on top. If the wires have moved from the point, bring them back one-half of the amount of the displacement. Try again, and repeat the operation if necessary.

The eye-piece may then be properly aligned and directed by the four screws (nearest the eye-end of the telescope), so that the field of view shall appear evenly divided by the cross-hairs, as already explained.

In this, as well as in any other telescope, we assume that the tubes are straight, the object-glass well centered, and the slide well fitted. If such be not the case, the telescope can only be adjusted for certain distances. It is urged by some makers that it is almost impossible to produce straight tubes, and that, therefore, the object-slide must be adjustable. This, however, is entirely erroneous. Perfectly straight tubes *can* be made, if the necessary time and money be expended, which is the only requisite. In a great many instruments sold today, it will be found that the object-glass is not centered, that the slide is poorly fitted, and that all these inaccuracies, which are not apparent at a glance, prove more injurious than ever if the tubes are not quite straight. It must also seem clear to any one that the constant working of the slide in an adjustable ring would loosen the screws and cause considerable annoyance.

PARALLAX is adjusted by moving the eye-piece in or out until a clear and distinct view of the cross-hairs is obtained, as in the case of the transit already described.

THE COLLAR TEST.—After the instrument is properly adjusted, the equality of the collars may be ascertained in the following manner:

Operation.—Make two bench-marks, place the instrument exactly midway between them, and find their true difference of level by reading leveling rods set upon them. Now place the instrument near one of the bench-marks and read the rods again. If the difference of the reading is equal to the true difference of level, the collars are of equal diameter, and the line of collimation is at right-angles to the vertical axis of the instrument. This test, once made, holds good ever after, as it shows that the collars are true, and consequently that a correct adjustment is assured of all its other parts, as already described. But it need hardly be mentioned that denting, the settling of sand particles and unequal wear will also affect the adjustment in the same manner.

If the test shows that the line of collimation is *not* perpendicular to the line of the vertical center, then the collars are of unequal diameter, and the instrument is really nothing more nor less than a dumpy level, as this defect deprives it of all the advantages for an easy and convenient adjustment, which characterizes the Y-level in comparison with the dumpy.

This defect may, however, be temporarily remedied or adjusted in the same manner as the line of collimation in the dumpy level is adjusted, but it must ever thereafter remain permanently in its Ys, as it would, if reversed end for end, double the error which existed previous to this adjustment.

The correction may also be made by displacing the horizontal cross-hair to the extent that the line of collimation shall be truly horizontal and, at the same time, parallel with the axis of the spirit level; but, in that event, there will be no longer any agreement with the optical axis, which again gives rise to a number of inaccuracies that cannot be obviated.

A Y-level, in order to deserve that name at all, must have equal diameters of its collars; and if that is not found after a crucial test, the instrument maker should be called upon to remedy this discrepancy.

No doubt can possibly exist in the mind of any engineer of the absolute necessity of the collar test. Considering the required parallelism of the axis of collimation and the axis of the spirit level, he must know that a contact can only be made between the telescope and Ys by means of the collars, whose exteriors may either be parts of the surface of a cylinder, or that of a cone, and that the required parallelism is

only possible in the former case. If one collar exceed the other in diameter, the centered level bubble, if reversed in the Ys, will indicate a displacement corresponding to four times the angle intercepted between the collar axis and that of the spirit level. No further demonstration of this fact is necessary.

Of the Dumpy Level

In principle, the same laws govern the requirements of the dumpy that hold good in the Y-level. Although its construction differs, the condition of its line of collimation, optical center and level vial must be such as to bear that universal relation to each other which we have fully explained in the other instruments. It is not difficult to make all the necessary adjustments properly, although it may not appear quite so handy to correct its errors as in the case of the Y-level. Once adjusted, however, the instrument will remain so for a long time, and it will give the operator considerable satisfaction, if used with the ordinary care.

The adjustments of the level, and the telescope for collimation, will now be briefly mentioned.

Put on the sun-shade, and focus the eye-piece until the hairs are distinctly visible and the parallax destroyed; then proceed as follows:

Operation.—Turn the instrument so that the telescope shall stand directly over the line of two opposing leveling screws, and draw the bubble to the middle of the tube by means of the foot-screws. Then turn the instrument on its center 180 degrees, and if the bubble remain centered the adjustment is perfect. Any displacement, however, will have to be corrected by taking up one-half of it with the capstan-headed screws attached to the level case, and the other half by the foot-screws. This operation must be repeated several times, in directions normal to each other—that is, over one set of opposing foot-screws as well as over the other, until the telescope may be swung in any position and the bubble will remain in the middle. See that the adjusting screws of the level vial are firm, yet avoid all unnecessary force in tightening them; all cramming is injurious, and tends to destroy the proper degree of refinement required.

After having set the diaphragm so that the cross-hairs shall be absolutely horizontal and vertical, which is easily done by loosening the capstan-headed screws and turning the diaphragm slightly, being guided by some point bisected by the horizontal hair, we now proceed to adjust the cross-hair, which must be brought into the collimation line. Several methods are known; the one which is always available,

however, is that by means of stakes and level-readings upon them, and it is to this that we shall confine ourselves here.

Operation.—Choose a piece of ground nearly level, set up the instrument and center the bubble. Drive a stake (point 1) firmly, say two hundred or three hundred feet from the instrument, in any convenient direction therefrom. Hold the level rod upon it and take a reading. Now point the telescope in the opposite direction, the bubble being centered, and plant another stake (point 2) at the same distance from the dumpy, driving it until the rod shall read the same as upon the first point. These two stakes are on the same level. Now set up the instrument about ten or fifteen feet from the first stake, and bring the bubble to the center; take a rod-reading on point 1, and then on point 2. If the two readings are alike, with a truly centered bubble, the hair is collimated. If there is any difference, take up nearly all of it by moving the diaphragm with the cross-hairs either up or down, as already explained. Repeat this operation until the readings on points 1 and 2 are identical, when the instrument is in adjustment.

The vertical hair is of no particular importance.

With these precautions, a dumpy level may be made absolutely accurate, and there is no reason why, for nearly all of the engineer's work, this compact and steady instrument should not meet every requirement. We frequently discuss its merits with our customers, and have never hesitated to recommend it.

Test of Telescopes in General

If a telescope is to be tested for its qualities, make sure that all its lenses are perfectly clean.

To test for *definition*, use small, clear print, and view it from a distance of from thirty to fifty feet. If the print appears clear and well defined, and fully as legible at this distance as if viewed with the naked eye at the distance of distinct vision, the surfaces of the object-glass are perfect and well finished. If, on the contrary, the print appears dull and indistinct, and the finer details illegible, or even invisible, the surfaces are imperfect and faulty, for the rays proceeding from the various points of the object are not refracted to their corresponding points in the image.

Indistinctness may be caused by *spherical aberration*.

To test this, cover the object-glass with a ring of black paper, reducing the aperture to one-half; again focus small print to distinct vision; remove the ring of black paper and cover the center of the object-glass (previously left open), then mark how much the object-

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glass has to be moved in or out for distinct vision. If the spherical aberration has been reduced to a minimum, very little, if any, slide motion is necessary to obtain a distinct view under both tests. The amount of movement, however, constitutes a measure for the spherical aberration of the object-glass.

Another test, but not as good as the one just mentioned, is to focus an object to distinct vision; then slide the object-glass in or out, observing at the same time the quantity of motion necessary to render the object indistinct. If the spherical aberration is completely corrected, the object should, theoretically, be rendered indistinct by the slightest motion of the lens; but, practically, this is not the case, as the eye will accommodate itself in a measure to the difference of divergence of the rays, caused by the motion, in or out, of the object-glass, in the same manner as it will accommodate itself to near and distant objects when viewing without the aid of lenses. So, if the image formed by a perfect object-glass is viewed by another perfect lens of long focal length, say six inches, the object-glass might be moved in or out one-fourth of an inch from the point of distinct vision, and the object will still appear comparatively clear, as the one-fourth-inch motion, with an eye-lens of such long focal length, cannot cause enough difference in the divergence of the rays to prevent the accommodation of most eyes to it. The shorter the focal length of the eye-lens, the more rapid will be the change of divergence or convergence of the rays with a certain amount of motion; therefore, the second test is only applicable with eye-pieces of very high power, which, at the slightest motion in or out, will cause a sufficient amount of divergence of the rays to prevent the accommodation of the eye to the change.

To test the *chromatic aberration*, either a celestial body or a white disc should be selected for an object.

Focus the object to distinct vision, thereupon move the object-glass slowly in and out alternately. If, in the first instance, a light yellow ring is seen at the edge of the object, and in the second one a ring of purple light, the object-glass may be considered perfect, as it proves that the most intense colors of the prismatic spectrum (orange and blue) are corrected.

To test the *flatness of field*, take a square, flat object, the sides of which are about four inches long and perfectly straight—the best object is a heavily-lined square, drawn on white paper with india ink. Sight this object from such a distance that it will nearly fill the field of view of the telescope, and see if it still appears flat and its sides perfectly

straight; if so, the telescope is a good one. If, on the contrary, the object appears distorted, *i. e.*, if the sides, instead of being straight, form curves and the surfaces appear concave, instead of flat, the telescope is not good, for it shows that the proportions of foci, aperture and distances between the different lenses are not according to the laws of optics; owing, generally, to the attempt to force the magnifying power beyond its limits.

As all the refractions of light in the telescope are caused by flat and spherical surfaces, it is evident that the edge of a round flat object, when used for the above test, cannot be distorted, but that the surface only will appear concave to a keen observing eye. A telescope which distorts the image to a perceptible degree will not, however, cause any errors in common use, if only one point in the lens is taken in all observations, but it is decidedly objectionable in stadia measurements, where two points in the field of view are used at the same time.

To Find the Magnifying Power of a Telescope

A practical method for finding the magnifying power, available to anyone, which does not require any apparatus, taking up only a few moments' time, is the following:

Set up the instrument, and about twenty or thirty feet therefrom hold up a graduated rod. Observe the rod with one eye by direct vision, and with the other through the telescope. Assume a certain space on the rod, say the height of a numeral, or two sharply drawn lines, and count the number of divisions on the rod in that space; then observe the number of divisions that are seen by the naked eye in the same space enlarged. The ratio between the two is the power sought. It is the reading of a magnified space of known length on the graduated face of the rod. With a little practice both eyes will be able to distinguish the rod divisions at the same time. If what is known to be 0.1 of a foot, is enlarged by viewing it through a telescope so as to cover the space of 2.4 feet as seen by the unaided eye, the magnifying power is 24 for the distance in focus. The real power is somewhat less, for as the tube of the telescope is drawn out for near objects, the power necessarily increases. The magnifying power obtained by this method holds good for the distance that the rod can be read by the unaided eye, and it is always somewhat greater than the actual power.

For a very accurate determination of the magnifying power, it is necessary to ascertain the focal length of the objective and that of the

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eye-piece, in order to compare them and to find their proportion. While the former is easily obtained by a direct measurement from the objective lens to the cross-hairs, the latter, usually containing an entire system of lenses, presents numerous difficulties. For this purpose we possess an apparatus especially designed for us.

Dividing the focal length of the objective (when the telescope is focused to mean distance) in millimeters, by the equivalent gives the magnifying power of the telescope under consideration.

If any of our customers want the focal length of an eye-piece determined, we shall cheerfully do so, without charge, upon receipt of it, which should be sent carefully packed.

Adjustments of the Plane-Table Alidade

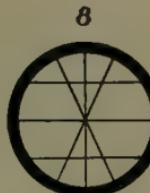
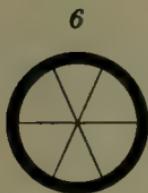
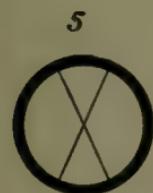
Without going again into all the details of instrumental adjustments, it behooves us to enumerate the points required of this instrument when in proper condition. These are:

- 1st—That the *fiducial edge* of the rule be absolutely straight;
- 2d—That all *parallax* be destroyed, by placing the cross-hairs in proper focus;
- 3d—That the line of collimation move in a vertical plane;
- 4th—That this plane be normal to the plane of the ruler;
- 5th—That the same plane also intersect the fiducial edge of the ruler, or at least be parallel thereto;
- 6th—That during parallelism of the optical axis and the fiducial edge, the zeros of the vertical arc and its vernier correspond.

This instrument is used in the topographical departments of the U. S. Coast and Geodetic Survey, and the U. S. Geological Survey, and is exclusively applied in mapping the topographical features of the country in Europe, usually by officers of the army, who control these surveys, after the triangulation points have been established.

This method of surveying has been constantly improved in practice, particularly by the experts of the Geological Survey, and it may be safely said that, with the required accuracy, nothing surpasses it for small-scaled work in speed and application. All the bulky parts of the table have been reduced to a minimum, so that it may be handled with comparative ease in the roughest mountain country.

CROSS HAIRS

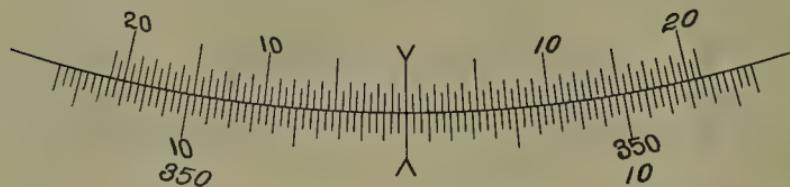


The cuts show the different cross hairs we set in our instruments as ordered. When ordering please indicate by number cross hairs wanted, as shown above. We employ No. 1 cross hairs and No. 2 stadia hairs unless otherwise specified.



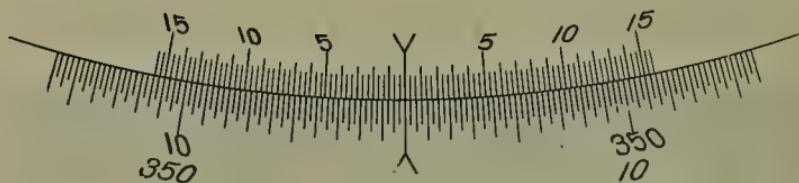
ASSEMBLING DEPARTMENT

METHODS OF GRADUATING LIETZ INSTRUMENTS



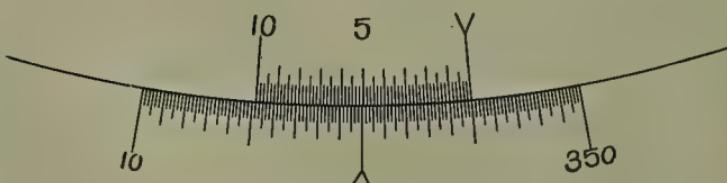
No. 1

Double vernier reading to 30". Circle graduated to 20'.



No. 2

Double vernier reading to 20". Circle graduated to 15'.



No. 3

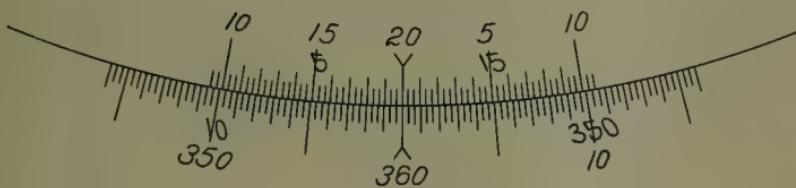
Single vernier reading to 10". Circle graduated to 10'
with one row of figures.

AND POPULAR STYLES OF VERNIERS FURNISHED



No. 4

Single vernier reading to 20". Circle graduated to 20'
with two rows of figures.



No. 5

Folding vernier reading to 20". Circle graduated to 20'
with two rows of figures.



No. 6

Double vernier reading to single minutes. Circle graduated to 30'.

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PART II

ILLUSTRATED CATALOGUE AND PRICE LIST OF

**MODERN ENGINEERS' AND SURVEYORS'
INSTRUMENTS**

AS MADE BY

THE A. LIETZ COMPANY

INTRODUCTION

The following illustrations show the principal articles we manufacture, being, in the case of this section, almost exclusively confined to instruments required by the civil, mining, irrigation, hydraulic and military engineer, for making accurate measurements and surveys for any purpose whatever.

Of the instruments each illustration, or plate, is complete within itself. Every feature is carefully noted, together with the price and a general description in a condensed form. The additional accessories that may be had in each instance are also enumerated and their prices given. It is well, however, that the engineer should consult the preceding part of this Manual, wherein every detail is carefully described and extensively discussed. If pains are taken to look this over, the reader will obtain such information as would be given him in the salesroom.

Every article has been numbered, and by these numbers our customers may order, without going into a minute description of the articles wanted. For example:

"Send me transit No. 4, with the following extras....." is all that is required to designate to us exactly what is desired.

In ordering please mention the issue of the catalogue, as the numbers of preceding issues necessarily conflict.

Also see Telegraph Code Words.

With the detailed information on its succeeding page, every plate becomes a complete price list of the particular instrument illustrated. Every effort has been made to make this part of the book as intelli-

gible as possible, without the necessity of searching over numerous pages to gather information.

Although we shall make any instrument of precision called for, we desire to state clearly that we have made a particular specialty of engineers' and surveyors' instruments, because there is for them alone a demand at the present time, and for this reason our shop facilities have been especially designed and improved for the manufacture of these articles.

If instruments for a more scientific purpose are wanted, for astronomical or geodetic work, for instance, we can either *make* them on a special order, or we can *import* them for our customer, having made arrangements in Europe which enable us to sell such instruments as cheaply as anyone in the United States.

All our products have been priced commensurate with their quality and deductions are not made from our price list.

We furnish a first-class article at a fair price, and our goods stand upon their individual merit. It has been our object to create the best that the instrument maker's art can make or devise, and with the records of the past decades before us we feel that we have been successful in every way.

THE A. LIETZ COMPANY.

TELEGRAPHIC CODE

THE A. LIETZ COMPANY

San Francisco, U. S. A.

Cable Address: CYCLOTOMIC, San Francisco, U. S. A.

**Use A. B. C., 5th Edition, or A. B. C., 5th Edition, Improved, or Bentley's
Codes in connection with our Private Code Words noted in our Catalog.**

O'SHAUGHNESSY DAM



The O'Shaughnessy Dam, hitherto known as Hetch Hetchy, now completed, was built to a height of $226\frac{1}{2}$ feet above stream level by the Utah Construction Company at a cost of \$5,500,000. The foundation is designed to support also a future addition to bring the height to 312 feet above stream level, with a length of 900 feet at the crest. The foundation extends 118 feet below stream level and is 298 feet long at the bottom. The dam contains 375,000 cubic yards of concrete and was completed on March 28, 1923, and will store 67,000,000,000 gallons of water. The ultimate storage will be 113,000,000,000 gallons. This dam will be the largest in California. The water of the river was turned through a by-pass tunnel 23 x 25 feet, 900 feet long, to permit construction work.

This is one of the many Great Engineering Projects constructed with Lietz Transits and Levels.

LIETZ ENGINEERS' TRANSITS AND THEODOLITES Nos. 1 to 5G

With 6 ¾ and 7-inch horizontal circle.
(Double spindle repeating)

These are elegant instruments, absolutely accurate in all working parts, designed for land surveying and engineering work of the highest character, and are guaranteed in every detail. The general dimensions are given to the right of each illustration, as well as the extras that may be added. The horizontal circle is graduated to read to either 60, 30 or 20 seconds and 10 seconds if ordered with the 7" horizontal circle, two verniers being provided and placed so as to afford a reading without stepping aside. The verticle arc or circle is graduated to read to 60 or 30 seconds. Each instrument has long compound centers, shifting plates on tripod head. The telescope possesses definition, light and power in a high degree. High-grade lenses, achromatic objective and eye-piece, erect vision. The telescope is reversible and evenly balanced, provided with slide protector and screw motion for focusing cross-hairs. Top of telescope provided with fine punch mark for centering instrument from a point above. Instruments are prepared to receive solar attachment or secondary telescope. Finished in torchon finish. The case has leather straps, rubber cushions, and contains all the usual accessories. For minute description of every detail, see first part of the Manual.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS



No. 1

LIETZ 6 1/4-INCH PLAIN PRECISION TRANSIT

Code Word, **BUGBEAR**

MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS THE A. LIETZ COMPANY
SAN FRANCISCO, U. S. A.

LIETZ ENGINEERS' TRANSIT No. 1

Dimensions and Weights

Horizontal Circle (measured to edge of graduation).....	6½ inches diam.
Compass Needle	4½ " long
Object Glass	1¼ " diam.
Telescope	11 " long
Magnifying power	24X
Weight.....Instrument, 14 lbs.; tripod, about 8 lbs.; box, about 10 lbs.	

Instrument as Usually Furnished

- No. 1. Plain Precision Transit, with 6½" horizontal circle, verniers reading to minutes; graduations on solid silver; cross hairs to telescope. Equipped with split-leg tripod. Instrument complete with plumb bob, reading glass, sunshade, adjusting pins, dust brush, etc., in neat polished mahogany caseCode Word, **BUGBEAR**

Extras for Transit No. 1

For which the additional charge is made. Kindly specify if desired.

	Code Word
Horizontal verniers reading to 30 seconds.....	CULLYISM
Horizontal verniers reading to 20 seconds,.....	CULMINATE
Stadia hairs fixed.....	CUPOLA
Variation ring to compass.....	CULPRIT
Arrangement for offsetting right angles.....	CULTIVATE
Gradienter attachment to vertical motion with movable head.	CULPABLE
Constructed with three leveling screws instead of four....	CULVERIN
Three leveling screw shifting center.....	CUMBER
One extension leg in lieu of one split leg.....	CURLY
Full extension tripod in lieu of straight legs.....	CUMBRANCE
Silk protection bag or hood (waterproof).....	CURTAIN
Bottle of fine instrument oil.....	CUTEX
Inverting eye-piece (made to order only);.....	CUTWATER

For complete list of features applicable to Lietz Transits see pages 88 and 89.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS



No. 2

LIETZ 6 1/4-INCH ENGINEERS' PRECISION TRANSIT

Like No. 1 but fitted with level and tangent to telescope.

Code Word, **BUGGY**

MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS THE A. LIETZ COMPANY
SAN FRANCISCO, U. S. A.

LIETZ ENGINEERS' TRANSIT No. 2

Dimensions and Weights

Horizontal Circle (measured to edge of graduation).....	6½ inches diam.
Compass Needle	4½ " long
Object Glass	1¼ " diam.
Telescope	11 " long
Magnifying power	24 X
Weight.....Instrument, 14½ lbs.; tripod, about 8 lbs.; box, about 10 lbs.	

Instruments as Usually Furnished

No. 2. Engineers' Precision Transit, with 6½" horizontal circle; verniers reading to minutes; graduations on solid silver; cross hairs to telescope; level and tangent to telescope. Equipped with split-leg tripod. Instrument complete with plumb bob, reading glass, sunshade, adjusting pins, dust brush, etc., in neat polished mahogany case.

.....Code Word, **BUGGY**

Extras for Transit No. 2

For which the additional charge is made. Kindly specify if desired.

	Code Word
Horizontal verniers reading to 30 seconds.....	CULLYISM
Horizontal verniers reading to 20 seconds.....	CULMINATE
Reversion level vial with protection ring.....	CULTURE
Variation ring to compass.....	CULPRIT
Arrangement for offsetting right angles.....	CULTIVATE
Stadia hairs, fixed, set 1:100	CUPOLA
Gradienter attachment to vertical motion with movable head.....	CULPABLE
Constructed with three leveling screws instead of four.....	CULVERIN
Three leveling screw shifting center.....	CUMBER
One extension leg in lieu of one split leg.....	CURLY
Full extension tripod in lieu of straight legs.....	CUMBRANCE
Silk protection bag or hood (waterproof).....	CURTAIN
Bottle of fine instrument oil.....	CUTEX
Inverting eye-piece (made to order only).....	CUTWATER

For complete list of features applicable to Lietz Transits see pages 88 and 89.

See price list in back of catalog.



No. 3
LIETZ 6 1/4-INCH ENGINEERS' PRECISION TRANSIT

With 5-inch Vertical Arc and double vernier reading to minutes.
Code Word, **BUGLEHORN**

No. 3W

Same as No. 3 but without Variation Ring to Compass.
Code Word, **BUGLESONG**

LIETZ ENGINEERS' TRANSITS Nos. 3 to 3W

Dimensions and Weights

Horizontal Circle (measured to edge of graduation).....	6½ inches diam.
Vertical Arc (measured to edge of graduation).....	5 " "
Compass Needle	4½ " long
Object Glass	1¼ " diam.
Telescope	11 " long
Magnifying power	24 X
Weight .....Instrument, 15 lbs; tripod, about 8 lbs.; box, about 10 lbs.	

Instruments as Generally Furnished

- No. 3.** Engineers' Precision Transit with 6½-inch horizontal circle and 5-inch vertical arc with vernier reading to minutes; graduations on solid silver throughout; level and tangent to telescope with fixed stadia hairs set 1:100; variation to compass ring. Equipped with split-leg tripod. Instrument complete with plumb bob, reading glass, sunshade, adjusting pins, dust brush, etc., in neat polished mahogany case.
.....Code Word, **BUGLEHORN**
- No. 3W.** Same as Transit No. 3 but without variation ring to compass.
.....Code Word, **BUGLESONG**

Extras for Transits Nos. 3 and 3W

For which the additional charge is made. Kindly specify if desired.

	Code Word
Horizontal verniers reading to 30 seconds.....	CULLYISM
Horizontal verniers reading to 20 seconds.....	CULMINATE
Reversion level vial with protection ring.....	CULTURE
Arrangement for offsetting right angles.....	CULTIVATE
Gradienter attachment to vertical motion with movable head..	CULPABLE
Prism to eye-piece, with neutral glass	CUMBERSOME
Colored object glass cap in lieu of ordinary.....	CUTLERY
Constructed with three leveling screws instead of four.....	CULVERIN
Three leveling screw shifting center.....	CUMBER
One extension leg in lieu of one split leg.....	CURLY
Full extension tripod in lieu of straight legs.....	CUMBRANCE
Silk protection bag or hood (waterproof).....	CURTAIN
Bottle of fine instrument oil.....	CUTEX
Inverting eye-piece (made to order only).....	CUTWATER

For complete list of features applicable to Lietz Transits see pages 88 and 89.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS



No. 4

**LIETZ 6 $\frac{1}{4}$ -INCH COMPLETE ENGINEERS'
TRANSIT**

With 5-inch full Vertical Circle and double vernier reading to minutes.
Code Word, **BUGLER**

No. 4W

Same as No. 4 but without Variation Ring to Compass.
Code Word, **BULLSEYE**

LIETZ ENGINEERS' TRANSITS Nos. 4 to 4W**Dimensions and Weights**

Horizontal Circle (measured to edge of graduation).....	6½ inches diam.
Vertical Circle (measured to edge of graduation).....	5 " "
Compass Needle	4½ " long
Object Glass	1¼ " diam.
Telescope	11 " long
Magnifying power	24 X
Weight.....	Instrument, 16½ lbs.; tripod, about 8 lbs.; box, about 10 lbs.

Instruments as Usually Furnished

- No. 4.** Complete Engineers' Precision Transit with 6½-inch horizontal circle and 5-inch full vertical circle fitted with aluminum guard; verniers reading to minutes; graduations on solid silver throughout; level and tangent to telescope with fixed stadia hairs set 1:100; variation to compass ring. Equipped with split-leg tripod. Instrument complete with plumb bob, reading glass, sunshade, adjusting pins, dust brush, etc., in neat polished mahogany case.....Code Word, **BUGLER**
- No. 4W.** Same as Transit No. 4 but without variation ring to compass.
.....Code Word, **BULLSEYE**

Extras for Transits Nos. 4 and 4W

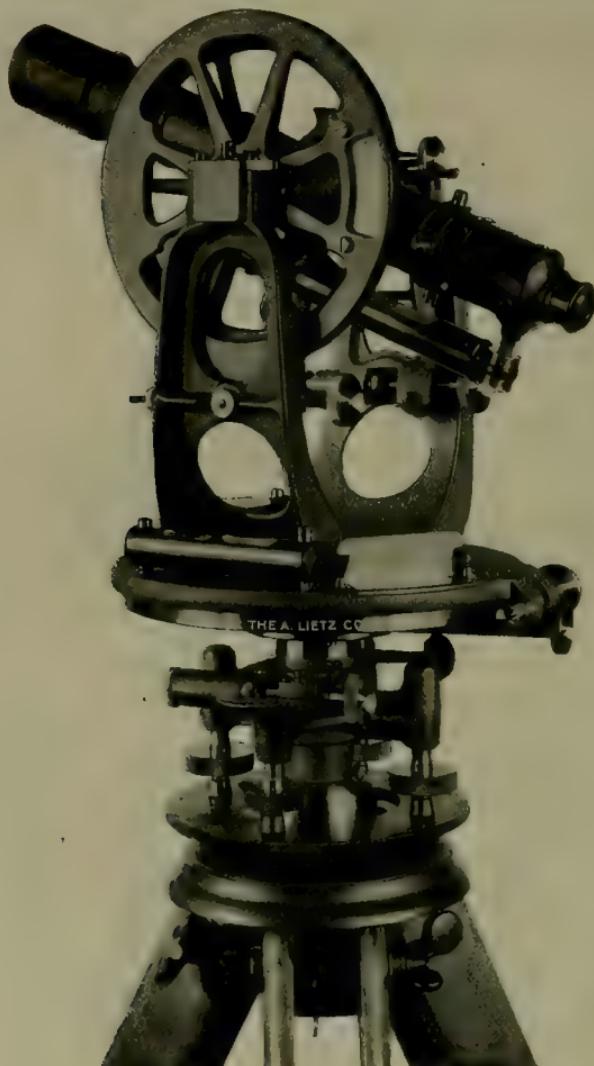
For which the additional charge is made. Kindly specify if desired.

	Code Word
Horizontal verniers reading to 30 seconds.....	CULLYISM
Horizontal verniers reading to 20 seconds.....	CULMINATE
Vertical circle graduated on the periphery.....	CUPBEARER
Reversion level vial with protection ring.....	CULTURE
Striding level to axis of telescope.....	CULTRATED
Arrangement for offsetting right angles.....	CULTIVATE
Gradienter attachment to vertical motion with movable head.	CULPABLE
Disappearing stadia hairs.....	CUPRIC
Prism to eye-piece, with neutral glass, see page 88.....	CUMBERSOME
Colored object glass cap in lieu of ordinary.....	CUTLERY
Constructed with three leveling screws instead of four.....	CULVERIN
Three leveling screw shifting center.....	CUMBER
One extension leg in lieu of one split leg.....	CURLY
Full extension tripod in lieu of straight legs.....	CUMBRANCE
Silk protection bag or hood (waterproof).....	CURTAIN
Bottle of fine instrument oil.....	CUTEX
Inverting eye-piece (made to order only).....	CUTWATER

For complete list of features applicable to Lietz Transits see pages 88 and 89.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS



No. 5

LIETZ 6 1/4-INCH TRANSIT THEODOLITE

With U-shaped Standards, Y Bearings, without Compass.
Code Word, **BULLFISH**

No. 5C

Same as No. 5 but with Circular Compass 3 1/2 inches diameter with
Variation Ring.
Code Word, **BULLETIN**

LIETZ TRANSIT THEODOLITES Nos. 5 to 5C**With U-shaped Standards and Y Bearings**

Lietz Transit Theodolites Nos. 5 and 5C have U-shaped standards of improved design, consisting of a one-piece casting. Transit No. 5 has no compass, but No. 5C is furnished with a compass, with a variation ring and a needle $3\frac{1}{2}$ " long. The U-shaped telescope support gives great stability in the upper structure, where lateral rigidity is most essential. The telescope has cylindrical pivots, which rest in wye bearings. This secures a greater refinement of motion in a vertical plane, and without stress. The telescope is reversible in position and exchangeable in its bearings, which are provided with dust caps and screws to give the necessary friction.

Dimensions and Weights

Horizontal Circle (measured to edge of graduation)....	6 $\frac{1}{4}$ inches diam.
Vertical Arc or Circle (measured to edge of graduation)...	5 " "
Telescope	11 " long
Object Glass	1 $\frac{1}{4}$ " diam.
Magnifying power	24 X
Weight .....Instrument, 16 lbs.; tripod, about 8 lbs.; box, about 10 lbs.	

Instruments as Usually Furnished

- No. 5.** Lietz Transit Theodolite with 5-inch full vertical circle and double vernier reading to minutes, fitted with aluminum guard, and 6 $\frac{1}{4}$ -inch horizontal circle with double opposite verniers reading to 30 seconds, graduations on solid silver throughout; level and tangent to telescope, with fixed stadia hairs set 1:100. Equipped with split-leg tripod. Instrument complete with plumb bob, reading glass, sunshade, adjusting pins, dust brush and all usual accessories in polished mahogany boxCode Word, **BULLFISH**
- No. 5C.** Same as No. 5 but with circular compass with variation ring and compass needle $3\frac{1}{2}$ inches long.....Code Word, **BULLETIN**

Extras for Nos. 5 to 5C

For which the additional charge is made. Kindly specify if desired.

	Code Word
Horizontal verniers reading to 20 seconds.....	CULMINATE
Reversion level vial with protection ring.....	CULTURE
Striding level to axis of telescope.....	CULTRATED
Gradienter attachment to vertical motion with movable head.....	CULPABLE
Opposite double verniers to vertical circle reading to minutes (in lieu of single vernier).....	CURATIVE
Two vernier microscopes.....	CURBING
Compass needle in box on plate 4 $\frac{1}{2}$ inches long.....	CURBLES
Full extension tripod in lieu of straight leg.....	CUMBRANCE
Silk protection bag or hood (waterproof).....	CURTAIN

For complete list of features applicable to Lietz Transits see pages 88 and 89.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS



**No. 5D
LIETZ TRANSIT THEODOLITE**

With 7-inch Horizontal Circle and opposite verniers reading to 10 seconds.
Code Word, **BUNGALOW**

No. 5DC

Same as No. 5D but with Circular Compass $3\frac{1}{2}$ inches diameter
with Variation Ring.
Code Word, **BUNTING**

LIETZ TRANSIT THEODOLITES Nos. 5D to 5DC

The general design and construction of these instruments is the same as that of our Transit Theodolites Nos. 5 and 5C, described and illustrated on pages 62 and 63, but Nos. 5D and 5DC have a 7" Horizontal Circle with opposite verniers reading to 10 seconds. Two vernier microscopes on swinging arm.

Dimensions and Weights

Horizontal Circle (measured to edge of graduation)....	7	inches diam.
Vertical Arc or Circle (measured to edge of graduation)...	5	" "
Telescope	11	" long
Object Glass	1 $\frac{3}{4}$	" diam.
Magnifying power	24 X	
Weight.....Instrument, 18 lbs.; tripod, about 8 lbs.; box, about 11 lbs.		

Instruments as Usually Furnished

- No. 5D.** Lietz Transit Theodolite with 5-inch full vertical circle and double vernier reading to minutes, fitted with aluminum guard; 7-inch Horizontal Circle with opposite verniers reading to 10 seconds; two vernier microscopes on swinging arm; graduations on solid silver throughout; level and tangent to telescope, with fixed stadia hairs set 1:100. Equipped with split-leg tripod. Instrument complete with plumb bob, reading glass, sunshade, adjusting pins, dust brush and all usual accessories, in polished mahogany case
.....Code Word, **BUNGALOW**
- No. 5DC.** Same as No. 5D but with Circular Compass with variation ring and compass needle 3 $\frac{1}{2}$ inches long.....Code Word, **BUNTING**

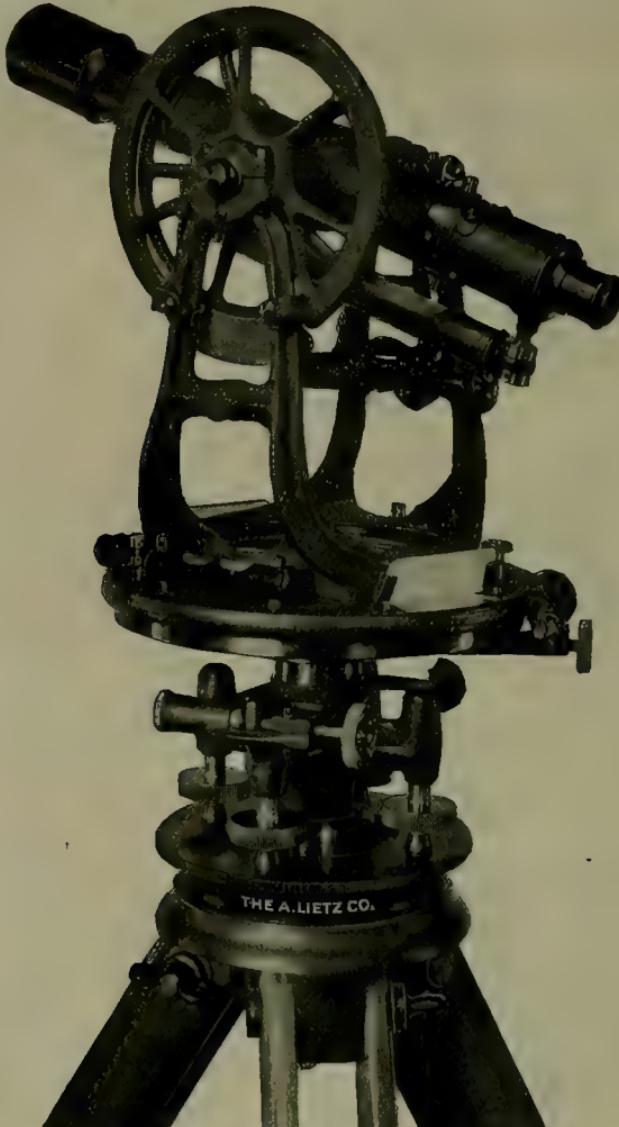
Extras for Transits Nos. 5D and 5DC

	Code Word
Reversion level vial with protection ring.....	CULTURE
Striding level to axis of telescope.....	CULTRATED
Gradienter attachment to vertical motion with movable head..	CULPABLE
Opposite double verniers to vertical circle reading to minutes (in lieu of single vernier).....	CURATIVE
Two vernier microscopes.....	CURBING
Compass needle in box on plate 4 $\frac{1}{2}$ inches long.....	CURBLES
Full extension tripod in lieu of straight legs.....	CUMBRANCE
Silk protection bag or hood (waterproof).....	CURTAIN
Bottle of fine instrument oil.....	CUTEX
Inverting eye-piece (made to order).....	CUTWATER

For complete list of features applicable to Lietz Transits see pages 88 and 89.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS



No. 5E

LIETZ TRANSIT THEODOLITE

With 6½-inch Horizontal Circle and 5-inch full Vertical Circle.
Code Word, **BUNTLINE**

No. 5F

Same as No. 5E but with 7-inch Horizontal Circle and opposite verniers
reading to 10 seconds.

Code Word, **BUNTWELL**

LIETZ TRANSIT THEODOLITES Nos. 5E to 5F

Lietz Transit Theodolites Nos. 5E and 5F have been constructed so as to obtain the highest amount of stability in the upper structure where lateral rigidity is most essential. The U-shaped telescope support is of a superior design, consisting of a one-piece casting with large circular base, which makes a more substantial connection to the upper plate and which also permits of a circular compass with variation ring and a compass needle $3\frac{1}{2}$ inches long. The sectional shape of this piece is of the "even cross" design, a characteristic of Lietz Instruments in all parts where the greatest stability is desirable with the least amount of material and weight.

Dimensions and Weights of No. 5E

Horizontal Circle, measuring to edge of graduation.....	6 $\frac{1}{4}$ inches diam.
Vertical Circle, measuring to edge of graduation.....	5 " "
Compass Needle	3 $\frac{1}{2}$ " long
Object Glass	1 $\frac{1}{4}$ " diam.
Telescope	11 " long
Magnifying power	24 X
Weight.....Instrument, 15 $\frac{1}{2}$ lbs.; tripod, about 8 lbs.; box, about 10 lbs.	

Instruments as Usually Furnished

- No. 5E.** Lietz Transit Theodolite with 5-inch full vertical circle and double vernier reading to minutes, fitted with aluminum guard, and 6 $\frac{1}{4}$ -inch horizontal circle with double opposite verniers reading to minutes; graduations on solid silver throughout; level and tangent to telescope, with fixed stadia hairs, set 1:100; variation ring to compass. Equipped with split-leg tripod. Instrument complete with plumb bob, reading glass, sunshade, adjusting pins, dust brush and all usual accessories, in polished mahogany box.....Code Word, **BUNTLINE**
- No. 5F.** Same as No. 5E but with 7-inch Horizontal Circle with opposite verniers reading to 10 seconds and two vernier microscopes on swinging arm.....Code Word, **BUNTWELL**

Extras for Transits Nos. 5E and 5F

For which the additional charge is made. Kindly specify if desired.

	Code Word
Horizontal verniers reading to 30 seconds.....	CULLYISM
Horizontal verniers reading to 20 seconds.....	CULMINATE
Vertical circle graduated on the periphery.....	CUPBEARER
Reversion level vial with protection ring.....	CULTURE
Striding level to axis of telescope.....	CULTRATED
Gradienter attachment to vertical motion with movable head.....	CULPABLE
Opposite double verniers to vertical circle reading to minutes (in lieu of single vernier).....	CURATIVE
Two vernier microscopes.....	CURBING
Full extension tripod in lieu of straight legs.....	CUMBRANCE
Silk protection bag or hood (waterproof).....	CURTAIN

For complete list of features applicable to Lietz Transits see pages 88 and 89.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS



No. 5G
LIETZ 7-INCH BOUNDARY THEODOLITE

United States Coast and Geodetic Survey Design.
For Triangulation and Boundary Line Surveys.
Code Word, **BURDOCK**

LIETZ 7-INCH BOUNDARY THEODOLITE No. 5G

SPECIFICATIONS

HORIZONTAL CIRCLE for repeating angles, 7 inches to edge of graduation with two rows of figures 0-360, graduated on solid silver, with opposite verniers reading to 10 seconds of arc. Two vernier microscopes on swinging arm.

VERTICAL CIRCLE, 5 inches to edge of graduation, graduated on solid silver, with two opposite double verniers reading to 30 seconds. Sensitive level attached to vernier arm. Two vernier microscopes.

TELESCOPE, 13 inches long, with two interchangeable inverting eye-pieces. Magnification 25 and 35 times respectively. Object Glass, 1 $\frac{3}{8}$ -inch diameter, clear aperture, prism to eye-piece with two dark glasses, long sensitive level to telescope. Releasable clamp and tangent screw. Cylindrical telescope axis and wye bearings. Striding Level resting on points of contact. Cross Hairs electrically illuminated through the axis of telescope, with emergency oil lamp.

CENTER made of steel fitted in cast-iron starpiece, with three leveling screws and shifting center.

STANDARD, U-shaped, cast in one piece with wye bearings. Entire instrument constructed so as to give the greatest amount of rigidity and accuracy.

WEIGHT: Instrument, 26 lbs.; tripod, 17 lbs.; two boxes, 26 lbs. For protection and portability the telescope is packed in separate carrying case from the base and standard of the instrument.

Code Word, **BURDOCK**



Gradienter Attachment to Vertical Motion
supplied with movable head which admits zero setting

Code Word, **CULPABLE**

For complete list of features applicable to Lietz Transits see page 89.

See price list in back of catalog.



PRIMARY TRIANGULATION OF THE PALOS VERDES PROJECT IN SOUTHERN CALIFORNIA

By WILLIAM W. MICHAEL, Assoc. M. Am., Soc. C. E.

The instrument used was a Lietz 7-inch repeating theodolite reading to 10 seconds of arc by two opposite verniers. Vertical circle of 5-inch diameter reading to 30 seconds with sensitive level vial attached to vernier arm. Telescope 13 inches long, with two inverting eye-pieces of 25 to 35 diameter magnification. Object glass 1 $\frac{3}{8}$ -inch clear aperture. Cylindrical telescope axis provided with striding level resting on points of contact. The entire instrument was constructed so as to give the greatest rigidity and accuracy. Microscopes were applied to verniers, and cross hairs could be illuminated through the horizontal axis by electric flashlight. Sensitiveness of level vials: telescope 15 to 20 seconds; striding level 10 seconds; plate levels 30 seconds. The instrument was packed in two separate boxes for protection and to facilitate transportation. For further description and illustration see pages 68 and 69.

LIETZ ENGINEERS' TRANSITS AND THEODOLITES Nos. 7 to 11E

**With 5" horizontal circle
(Double spindle repeating)**

These instruments are in every respect equal to the 6 $\frac{1}{4}$ " and 7", but are smaller in size and lighter in weight. The horizontal circle is graduated to read to single minutes by two double verniers which are placed so as to afford easy reading without stepping aside. The vertical arc or circle is graduated to read to single minutes. These instruments are recommended where less weight and bulk are desirable. The upper structure is somewhat reduced in proportion as compared with the larger instruments, thereby offering less resistance to the wind and offering greater stability. While these instruments are used to advantage for Mining, Mountain and Road work, their quality is such that they can be used for any kind of engineering work requiring accuracy. They have frequently been used for triangulation, with very satisfactory results.

The top of the telescope is provided with a fine punch mark for centering instrument from a point above, and the instrument is prepared to receive Solar Attachments or Secondary Telescope.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.



No. 7

LIETZ 5-INCH ENGINEERS' PRECISION TRANSIT

With Level and Tangent to Telescope.

Code Word, **BULBOUS**

LIETZ ENGINEERS' TRANSIT No. 7

Dimensions and Weights

Horizontal Circle (measured to edge of graduation).....	5	inches diam.
Compass Needle	3½	" long
Object Glass	1	" diam.
Telescope	8½	" long
Magnifying power		18 X
Weight..... Instrument, 9½ lbs.; tripod, about 9 lbs.; box, about 7 lbs.		

Instruments as Usually Furnished

No. 7. Engineers' Precision Transit with 5-inch horizontal circle, verniers reading to minutes, graduations on solid silver; cross hairs to telescope; level and tangent to telescope. Equipped with split-leg tripod. Instrument complete with plumb bob, reading glass, sunshade, adjusting pins, dust brush, etc., in polished mahogany case.

Code Word, **BULBOUS**

Extras for Transit No. 7

For which the additional charge is made. Kindly specify if desired.

	Code Word
Reversion level vial with protection ring.....	CULTURE
Variation ring to compass.....	CULPRIT
Arrangement for offsetting right angles.....	CULTIVATE
Stadia hairs, fixed, set 1:100.....	CUPOLA
Gradienter attachment to vertical motion with movable head.....	CULPABLE
One extension leg in lieu of one split leg.....	CURLY
Full extension tripod in lieu of straight legs.....	CUMBRANCE
Silk protection bag or hood (waterproof).....	CURTAIN
Bottle of fine instrument oil.....	CUTEX
Inverting eye-piece (made to order only).....	CUTWATER

For complete list of features applicable to Lietz Transits see pages 88 and 89.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS



No. 8

LIETZ 5-INCH ENGINEERS' PRECISION TRANSIT

With 4-inch Vertical Arc and double vernier reading to minutes.
Code Word, **BULGED**

No. 8W

Same as No. 8 but without Variation Ring to Compass.
Code Word, **BULBERT**

MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS THE A. LIETZ COMPANY
SAN FRANCISCO, U. S. A.

LIETZ ENGINEERS' TRANSITS Nos. 8 and 8W

Dimensions and Weights

Horizontal Circle (measured to edge of graduation).....	5	inches diam.
Vertical Arc	4	" "
Compass Needle.....	3½	" long
Object Glass	1	" diam.
Telescope	8½	" long
Magnifying power		18 X
Weight.....Instrument, 10 lbs.; tripod, about 8½ lbs.; box, about 7 lbs.		

Instruments as Usually Furnished

No. 8. Engineers' Precision Transit with 5-inch horizontal circle, verniers reading to minutes and 4-inch vertical arc with vernier reading to minutes; graduations on solid silver; level and tangent to telescope, with fixed stadia hairs, set 1:100; variation ring to compass. Equipped with extension tripod. Instrument complete with plumb bob, reading glass, sunshade, adjusting pins, dust brush, etc., in polished mahogany case	Code Word, BULGED
No. 8W. Same as No. 8 but without variation ring to compass.	Code Word, BULBERT

Extras for Transits Nos. 8 and 8W

	Code Word
Reversion Level vial with protection ring.....	CULTURE
Arrangement for offsetting right angles.....	CULTIVATE
Gradienter attachment to vertical motion with movable head.....	CULPABLE
Prism to eye-piece, with neutral glass, see page 88.....	CUMBERSOME
Colored object glass cap in lieu of ordinary.....	CUTLERY
Constructed with three leveling screws instead of four.....	CULVERIN
Three leveling screw shifting center.....	CUMBER
Silk protection bag or hood (waterproof).....	CURTAIN
Bottle of fine instrument oil.....	CUTEX
Inverting eye-piece (made to order only).....	CUTWATER

SOLAR ATTACHMENTS AND SECONDARY TELESCOPES

For further description and illustrations see pages 90 to 93.

	Code Word
Saegmuller Solar Attachment with counterpoise.....	CUMBROUS
Smith Solar Attachment with counterpoise.....	CURATOR
Burt Solar Attachment with counterpoise.....	CUTICLE
Attachable secondary telescope (side or top) with counterpoise	CUNEATED
Davis Solar Screen	CUSTARD

For complete list of features applicable to Lietz Transits see pages 88 and 89.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.



No. 9

LIETZ 5-INCH ENGINEERS' PRECISION TRANSIT

With 4-inch full Vertical Circle and double vernier reading to minutes.
Code Word, **BULIMY**

No. 9W

Same as No. 9 but without Variation Ring to Compass.
Code Word, **BULKHEAD**

LIETZ ENGINEERS' TRANSITS Nos. 9 and 9W**Dimensions and Weights**

Horizontal Circle (measured to edge of graduation).....	5	inches diam.
Vertical Circle (measured to edge of graduation).....	4	" "
Compass Needle	3½	" long
Object Glass	1	" diam.
Telescope	8½	" long
Magnifying power		18×
Weight.....Instrument, 10 lbs.; tripod, about 8½ lbs.; box, about 7 lbs.		

Instruments as Usually Furnished

- No. 9.** Engineers' Precision Transit with 5-inch horizontal circle, verniers reading to minutes and 4-inch full vertical circle fitted with aluminum guard and vernier reading to minutes; graduations on solid silver; level and tangent to telescope, with fixed stadia hairs, set 1:100; variation ring to compass. Equipped with extension tripod. Instrument complete with plumb bob, reading glass, sunshade, adjusting pins, dust brush, etc., in polished mahogany case.. Code Word, **BULIMY**
- No. 9W.** Same as No. 9 but without variation ring to compass.
.....Code Word, **BULKHEAD**

Extras for Transits Nos. 9 and 9W

	Code Word
Reversion level vial with protection ring.....	CULTURE
Arrangement for offsetting right angles.....	CULTIVATE
Gradienter attachment to vertical motion with movable head.....	CULPABLE
Prism to eye-piece with neutral glass, see page 88.....	CUMBERSOME
Colored object glass cap in lieu of ordinary.....	CUTLERY
Constructed with three leveling screws instead of four.....	CULVERIN
Three leveling screw shifting center.....	CUMBER
Silk protection bag or hood (waterproof).....	CURTAIN
Bottle of fine instrument oil.....	CUTEX
Inverting eye-piece (made to order only).....	CUTWATER

SOLAR ATTACHMENTS AND SECONDARY TELESCOPES

For further description and illustrations see pages 90-93.

	Code Word
Saegmuller Solar Attachment with counterpoise.....	CUMBROUS
Smith Solar Attachment with counterpoise.....	CURATOR
Burt Solar Attachment with counterpoise.....	CUTICLE
Attachable Secondary Telescope (side and top) with counterpoise	CUNEATED
Davis Solar Screen.....	CUSTARD

For complete list of features applicable to Lietz Transits see pages 88 and 89

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS



No. 11

LIETZ 5-INCH TRANSIT THEODOLITE

With U-shaped standards and Y bearings without compass.
Code Word, **BULKTOWN**

No. 11C

Same as No. 11, but with Circular Compass, $2\frac{1}{2}$ inches diameter
with variation ring.
Code Word, **BULKVILLE**

LIETZ TRANSIT THEODOLITES Nos. 11 to 11C

With U-shaped Standards and Y Bearings

These Instruments are of the same type and embody the same characteristics as our Nos. 5 and 5C, but they are of a smaller size, therefore lighter and more portable. The telescope has cylindrical pivots which rest in Y Bearings and is reversible in position and exchangeable in its bearings, which are provided with dustcaps and screws to give the necessary friction.

Dimensions and Weights

Horizontal Circle (measured to edge of graduation).....	5	inches diam.
Vertical Circle (measured to edge of graduation).....	4	" "
Object Glass	1	" "
Telescope	8	" long
Magnifying power		18 X
Weight.....Instrument, 10 lbs.; tripod, about 8 lbs.; box, about 6½ lbs.		

Instruments as Usually Furnished

- No. 11.** Lietz Transit Theodolite with 5-inch horizontal circle, verniers reading to minutes and 4-inch full vertical circle fitted with aluminum guard and vernier reading to minutes. Graduations on solid silver; level and tangent to telescope, with fixed stadia hairs set 1:100. Equipped with split-leg tripod. Instrument complete with plumb bob, reading glass, sunshade, adjusting pins, dust brush and all usual accessories in polished mahogany case.....Code Word, **BULKTOWN**
- No. 11C.** Same as No. 11 but with Circular Compass with variation ring and compass needle 2½ inches long.....Code Word, **BULKVILLE**

Extras for Nos. 11 to 11C

	Code Word
Horizontal verniers reading to 30 seconds.....	CULLYISM
Two vernier microscopes.....	CURBING
Reversion level vial with protection ring.....	CULTURE
Striding level to axis of telescope.....	CULTRATED
Gradienter attachment to vertical motion with movable head.....	CULPABLE
Prism to eye-piece with neutral glass.....	CUMBERSOME
Compass needle in box on plate 4½ inches long.....	CURBLES
Full extension tripod in lieu of straight legs.....	CUMBRANCE
Silk protection bag or hood (waterproof).....	CURTAIN
Bottle of fine instrument oil.....	CUTEX
Inverting eye-piece (made to order only).....	CUTWATER

For complete list of features applicable to Lietz Transits see pages 88 and 89.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS



No. 11E

LIETZ TRANSIT THEODOLITE

With 5-inch Horizontal Circle and 4-inch full Vertical Circle.
Code Word, **BULLFINCH**

MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS THE A. LIETZ COMPANY
SAN FRANCISCO, U. S. A.

LIETZ TRANSIT THEODOLITE No. 11E

This is the same type of instrument as our Nos. 5E and 5F but of a smaller and more portable size. A compact and accurate instrument incorporating the characteristics of construction and stability as obtained in the larger instruments.

Dimensions and Weights

Horizontal Circle, measuring to edge of graduation.....	5	inches diam.
Vertical Circle, measuring to edge of graduation.....	4	" "
Compass Needle.....	2½	" long
Object Glass	1	" diam.
Telescope	8	" long
Magnifying power		18×
Weight.....Instrument, 10 lbs.; tripod, about 8 lbs.; box, about 6½ lbs.		

Instrument as Usually Furnished

No. 11E. Lietz Transit Theodolite with 5-inch horizontal circle, verniers reading to minutes and 4-inch full vertical circle fitted with aluminum guard and vernier reading to minutes. Graduations on solid silver; level and tangent to telescope, with fixed stadia hairs set 1:100. Variation ring to compass. Equipped with split-leg tripod. Instrument complete with plumb bob, reading glass, sunshade, adjusting pins, dust brush and all usual accessories, in polished mahogany box.
.....Code Word, **BULLFINCH**

Extras for No. 11E

	Code Word
Horizontal verniers reading to 30 seconds.....	CULLYISM
Two vernier microscopes.....	CURBING
Reversion level vial with protection ring.....	CULTURE
Striding level to axis of telescope.....	CULTRATED
Gradiometer attachment to vertical motion with movable head.....	CULPABLE
Prism to eye-piece with neutral glass.....	CUMBERSOME
Full extension tripod in lieu of straight legs.....	CUMBRANCE
Silk protection bag or hood (waterproof).....	CURTAIN
Bottle of fine instrument oil.....	CUTEX
Inverting eye-piece (made to order only).....	CUTWATER

For complete list of features applicable to Lietz Transits see pages 88 and 89.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

THE CARQUINEZ BRIDGE



Lietz Transit Theodolite Number 5D controls location and elevation of the mammoth Carquinez Straits Bridge. For complete description and illustration of this instrument see pages 64 and 65.

The construction of the Carquinez Bridge will give Central California the unique distinction of having one of the largest structures of its kind in the world.

The length of this majestic masterpiece of engineering will be 3350 feet, or practically two-thirds of a mile. The clearance height for ships will be 135 feet above high water, the same as for the big bridges in New York City.

LEATHER COVERS FOR INSTRUMENT BOXES

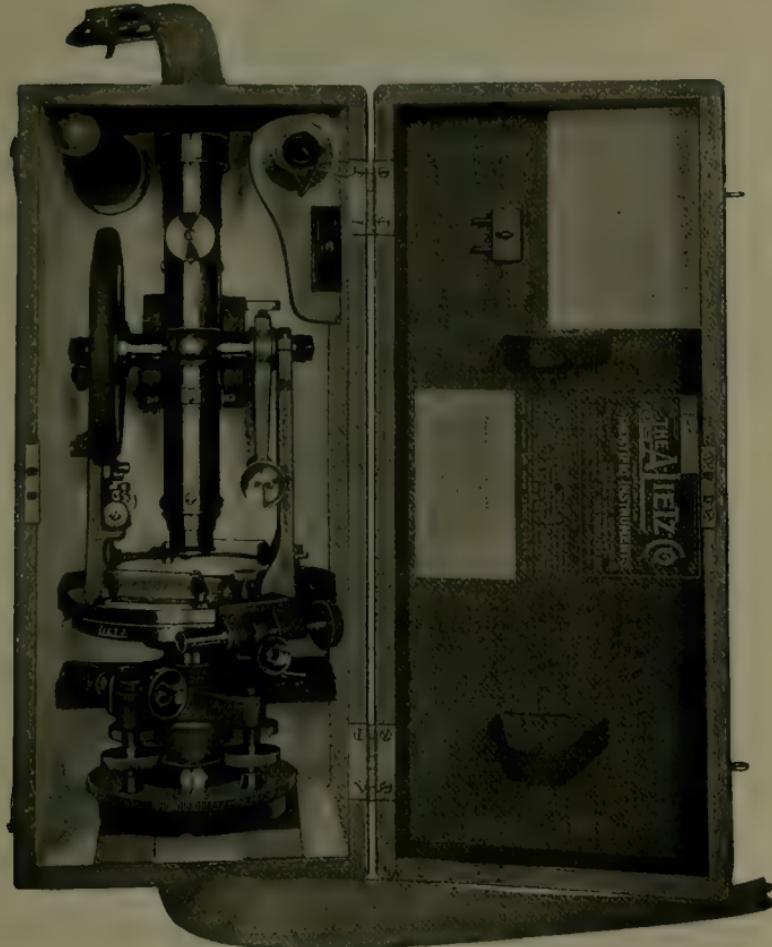


Special Leather Carrying Cases. See page 89. Code Word, CYCLOID

See price list in back of catalog.

LIETZ ENGINEERS' TRANSITS AND THEODOLITES
Nos. 12 to 14C

With 4" horizontal circle
(Double spindle repeating)



LIETZ MOUNTAIN AND MINING TRANSIT No. 12
In Case

These instruments have been constructed and are recommended where great portability and lightness are desirable. They are in every respect equal to and have all the features of our larger transits with 6 $\frac{1}{4}$ and 5" plates. In addition to their portability, this type permits of measuring greater vertical angles, which is often necessary in Mountain and Mining work, where the engineer is confronted with steep vertical angular requirements. These instruments are also prepared to receive the side or top telescope for extreme or prime verticals, and the top of the telescope is provided with a fine punch mark for centering the instrument from a point above. On account of their accuracy and stability, these instruments can be used for any kind of engineering work.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS



No. 12

**LIETZ 4-INCH MOUNTAIN AND RECONNAISSANCE
TRANSIT**

Code Word, **BULLCALF**

No. 12W

Same as No. 12 but without Variation Ring to Compass.
Code Word, **BULLRUN**

LIETZ MOUNTAIN AND MINING TRANSITS

Nos. 12 and 12W

Dimensions and Weights

Horizontal Circle, measuring to edge of graduation.....	4	inches diam.
Vertical Circle, measuring to edge of graduation.....	4	" "
Compass Needle	2½	" long
Object Glass	1	" diam.
Telescope	8	" long
Magnifying power		18 X
Weight.....Instrument, 7½ lbs.; tripod, about 8½ lbs.; box, about 4 lbs.		

Instruments as Usually Furnished

- No. 12.** Lietz Mountain and Mining Transit with 4-inch horizontal circle, verniers reading to minutes and 4-inch full vertical circle fitted with aluminum guard and vernier reading to minutes; graduations on solid silver; level and tangent to telescope, with fixed stadia hairs, set 1:100. Variation ring to compass. Equipped with extension tripod. Instrument complete with plumb bob, sunshade, adjusting pins, dust brush, etc., in polished mahogany case..Code Word, **BULLCALF**
- No. 12W.** Same as No. 12 but without variation ring to compass.
.....Code Word, **BULLRUN**

Extras for Transits Nos. 12 and 12W

	Code Word
Reversion level and protection ring.....	CULTURE
Prism to eye-piece with neutral glass.....	CUMBERSOME
Constructed with three leveling screws instead of four.....	CULVERIN
Three leveling screw shifting center.....	CUMBER
Gradienter attachment with movable head.....	CULPABLE
Silk protection bag or hood (waterproof).....	CURTAIN
Bottle of fine instrument oil.....	CUTEX
Inverting eye-piece (made to order only).....	CUTWATER

SOLAR ATTACHMENTS AND SECONDARY TELESCOPES

For further description and illustration see pages 90-93.

	Code Word
Saegmuller Solar Attachment with counterpoise.....	CUMBROUS
Smith Solar Attachment with counterpoise.....	CURATOR
Burt Solar Attachment with counterpoise.....	CUTICLE
Attachable secondary telescope (side and top) with counter- poise	CUNEATED
Davis Solar Screen	CUSTARD

For complete list of features applicable to Lietz Transits see pages 83 and 89.

See price list in back of catalog.



No. 14C

LIETZ 4-INCH TRANSIT THEODOLITE

With U-shaped standards and Y bearings and with Circular Compass.
Code Word, **BULWING**

NOTE: Instrument complete with FULL VERTICAL CIRCLE. Illustration shows Vertical Arc only.

LIETZ TRANSIT THEODOLITE No. 14C

With U-shaped Standards and Y Bearings

Similar in design and incorporating the characteristics of our Nos. 5C and 11C Theodolites. The U-shape standard is of superior design and obtains lateral rigidity to the highest degree. Telescope with cylindrical pivots which rest in Y bearings is reversible in position and exchangeable in its bearings. Instrument has compass with variation ring and needle 2½ inches long.

Dimensions and Weights

Horizontal Circle, measuring to edge of graduation.....	4	inches diam.
Vertical Arc or Circle, measuring to edge of graduation....	4	" "
Compass Needle	2½	" long
Object Glass	1	" diam.
Telescope	8	" long
Magnifying power		18×
Weight.....Instrument, 7½ lbs.; tripod, about 8½ lbs.; box, about 4 lbs.		

Instruments as Usually Furnished

No. 14C. Lietz Transit Theodolite with 4-inch horizontal circle, verniers reading to minutes and 4-inch full vertical circle fitted with aluminum guard and vernier reading to minutes; graduations on solid silver; level and tangent to telescope, with fixed stadia hairs, set 1:100. Variation ring to compass. Equipped with extension tripod. Instrument complete with plumb bob, sunshade, adjusting pins, dust brush and all usual accessories, in polished mahogany case.
.....Code Word, **BULWING**

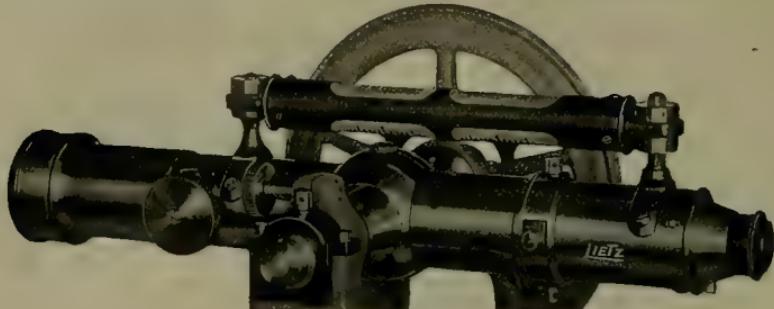
Extras for Transit Theodolite No. 14C

	Code Word
Reversion level vial with protection ring.....	CULTURE
Striding level to axis of telescope.....	CULTRATED
Constructed with three leveling screws instead of four....	CULVERIN
Three leveling screw shifting center.....	CUMBER
Gradienter attachment with movable head.....	CULPABLE
Prism to eye-piece with neutral glass.....	CUMBERSOME
Silk protection bag or hood (waterproof).....	CURTAIN
Bottle of fine instrument oil.....	CUTEX
Inverting eye-piece (made to order only).....	CUTWATER

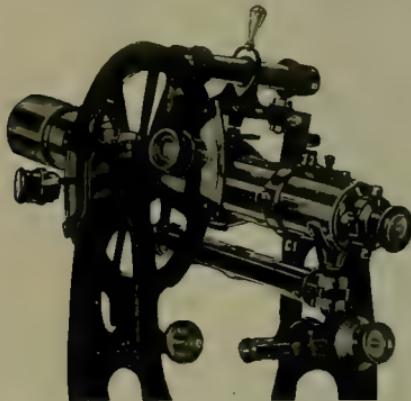
For complete list of features applicable to Lietz Transits see pages 88 and 89.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS



REVERSION LEVEL
For leveling with telescope on back sight. Applicable
to any of our transits.
Code Word, **CULTURE**



DOUBLE OPPOSITE VERNIER ATTACHMENT
Code Word, **CURATIVE**
Two Vernier Microscopes. Code Word, **CURBING**



**VERTICAL CIRCLE
GRADUATED ON
PERIPHERY**
Code Word,
CUPBEARER



**ATTACHABLE PRISM
TO EYE-PIECE**
Code Word, **CUMBERSOME**



**REFLECTOR SHADE FOR ILLUMINATING
CROSS HAIRS**
Code Word, **CUNEIFORM**

Gradiometer, see page 69.
See price list in back of catalog.

COMPLETE LIST OF FEATURES APPLICABLE TO LIETZ INSTRUMENTS

For which additional charge is made when not included in the specifications
and prices as quoted in price lists. Please specify if desired.

	Code Word
Horizontal verniers reading to 30 seconds.....	CULLYISM
Horizontal verniers reading to 20 seconds.....	CULMINATE
Horizontal verniers reading to 10 seconds.....	CURABLE
Stadia hairs fixed.....	CUPOLA
Disappearing stadia hairs.....	CUPRIC
Variation ring to compass.....	CULPRIT
Arrangement for offsetting right angles.....	CULTIVATE
Gradienter attachment to vertical motion with movable head (see page 69).....	CULPABLE
Constructed with three leveling screws instead of four.....	CULVERIN
Three leveling screws shifting center.....	CUMBER
Striding level to axis of telescope.....	CULTRATED
Beaman Stadia Arc	DIAMOND
Reversion level with protective housing in lieu of ordinary.....	CULTURE
Level for vernier arm for control of zero on vernier.....	DIAGNOSE
Prism to eye-piece with neutral glasses (see page 88).....	CUMBERSOME
Colored glass object cap.....	CUTLERY
Colored glass eye-piece cap.....	CUTLET
Colored glass in shutter of cap.....	CUTAWAY
Elbow zenith eye-piece.....	CUTLASS
Guard to vertical circle.....	CUMSHAW
Vertical circle graduated on the periphery with guard.....	CUPBEARER
Vertical circle with two opposite verniers in lieu of single	CURATIVE
Two vernier microscopes.....	CURBING
Mining bracket for mounting transits in mines.....	CUTWORM
Lateral adjustor for transits with four leveling screws.....	CUPLING
One extension leg in lieu of one split leg.....	CURLY
Full extension tripod instead of straight legs.....	CUMBRANCE
Protection bag, silk, waterproof.....	CURTAIN
Inverting eye-piece (made to order only).....	CUTWATER
Reflector for illuminating cross hairs.....	CUNEIFORM
Compass needle in box on plate, 4½" long.....	CURBLES
Mirror to control bubble from the end.....	CUPID
Agate-fitted wyes	CUPIDITY
Trough compass for alidade.....	DROUGHT
Leather cover for transit box with shoulder straps.....	CYCLOID

Note: Solar attachments and secondary telescopes, see pages 90-93.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

**SAEGMUELLER
SOLAR
ATTACHMENT**



Illustrating use of Saegmueller Solar Attachment as secondary telescope for vertical sighting.

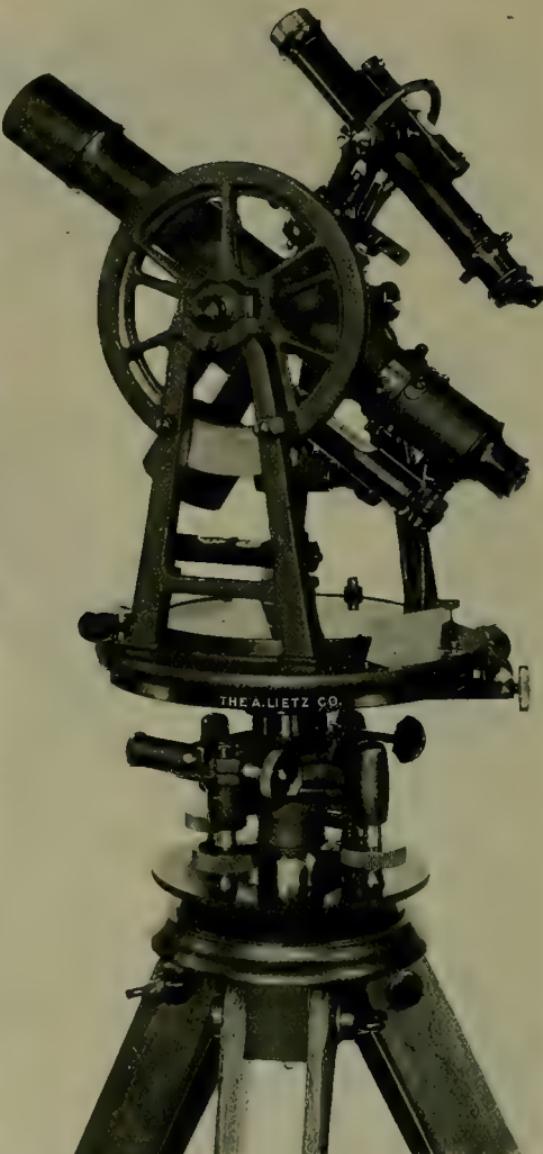
This solar attachment is detachable; it screws into the top of the telescope axis, and becomes a part of the instrument. It answers the purpose of a side telescope, as shown above. Made in two sizes suitable for engineers' instruments and for the mountain and mining instruments.

**No. 16. Saegmueller
Solar Attachment
(either size)**

Code Word,
CUMBROUS

Price includes fitting with new instrument.

Nominal charge made when fitted to used transit.



Illustrating Lietz Transit No. 4 fitted with
Saegmueller Solar Attachment.

See price list in back of catalog.

SMITH SOLAR ATTACHMENT



Illustrating Lietz Transit No. 9 fitted with
Smith Solar Attachment.

This attachment is fitted permanently to the instrument and therefore becomes part thereof.

No. 16S Smith Solar Attachment.....Code Word, CURATOR
Price includes fitting with new transit.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS



BURT SOLAR ATTACHMENT

No. 16B

Burt Solar Attachment. This Solar Attachment is detachable; it is screwed into the top of the telescope axis and becomes part of the instrument.

Code Word, **CUTICLE**.

Price includes fitting with new instrument.

DAVIS SOLAR SCREEN

No. 17D

Davis Solar Screen with prism for eye-piece of transit.

This permits of taking sun observations direct with the instrument telescope. It can be attached to any transit with a vertical circle or vertical arc.

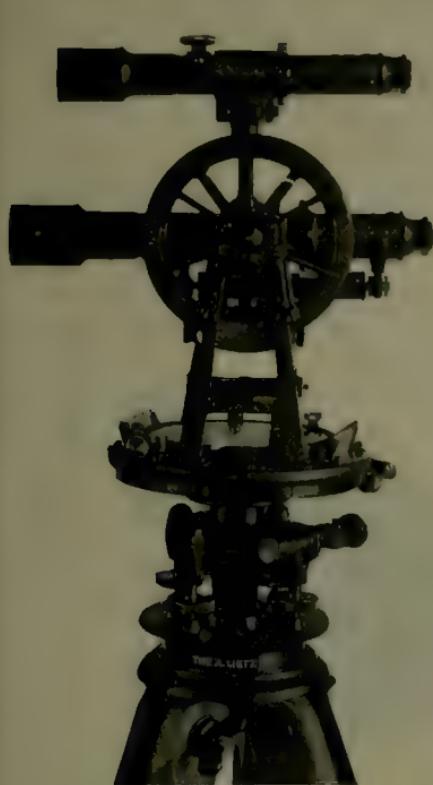
Code Word, **CUSTARD**

Price includes fitting with new instrument.



See price list in back of catalog.

LIETZ ATTACHABLE SECONDARY TELESCOPE



Showing Secondary Telescope in position on top for measuring horizontal angles.



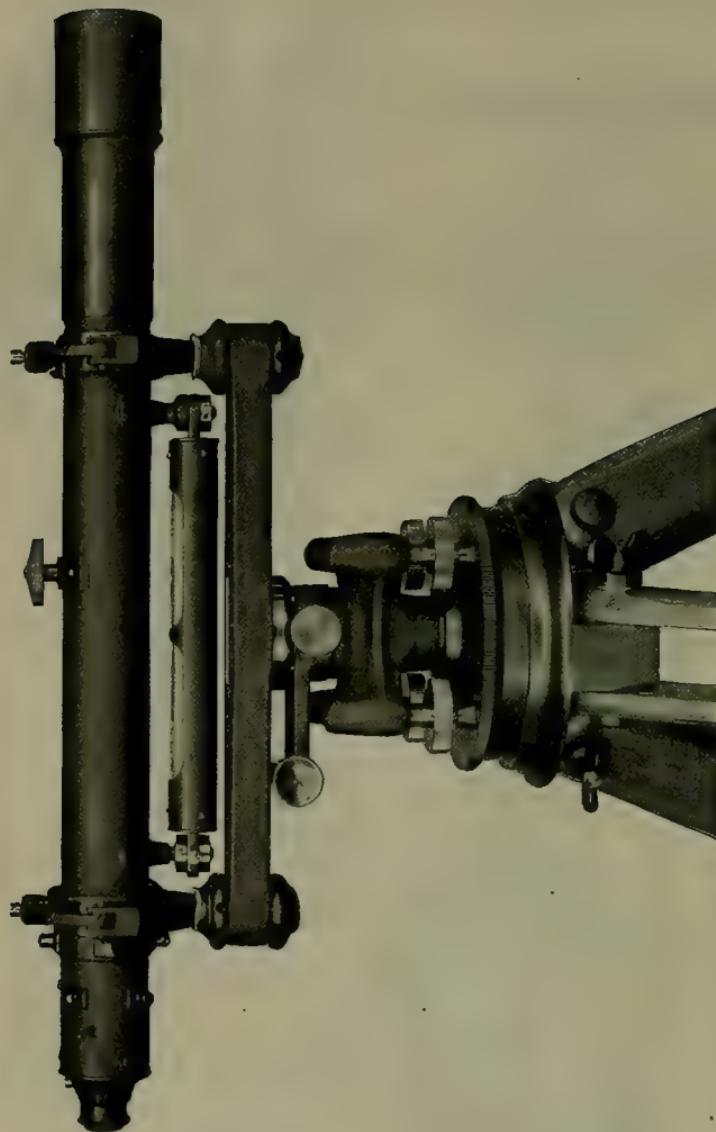
Showing Secondary Telescope in position on the side for measuring vertical angles.

No. 17. Attachable Secondary Telescope with counterpoise.
Code Word, **CUNEATED**

Lietz Secondary Telescope is detachable and interchangeable. It may be attached to the top or the side of the instrument as conditions require. Price includes fitting with new instrument.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS



No. 19
LIETZ ENGINEERS' PRECISION Y LEVEL
Code Word, BUMBOAT

LIETZ ENGINEERS' PRECISION Y LEVEL No. 19

This instrument is constructed to secure the greatest amount of stability without adding to its weight. Improved reinforced bar and ribbed construction of the starpiece. Long center, with clamp and tangent. Sensitive spirit level. Telescope has definition, light and power in a high degree and is provided with slide protector. The collars are made of our special hard metal and equalized with great care.

Dimensions and Weights

Length of telescope.....	18	inches
Diameter of objective.....	1 $\frac{1}{8}$	"
Magnifying power	33	×
Weight.....Instrument, 11 lbs.; tripod, about 8 $\frac{1}{2}$ lbs.; box, about 8 lbs.		

Instrument as Usually Furnished

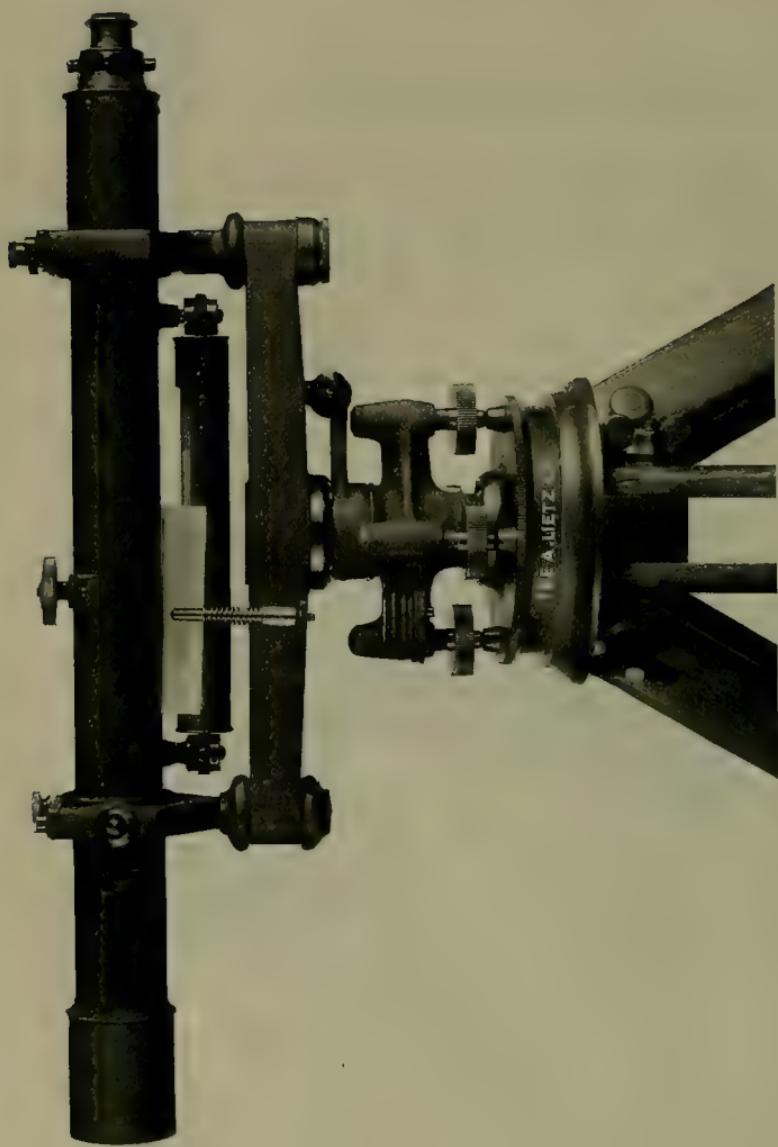
- No. 19. Lietz Engineers' Precision Y Level, equipped with split-leg tripod. Instrument complete with sunshade, dust brush, adjusting pins, and all usual accessories, in polished mahogany box.
.....Code Word, **BUMBOAT**

Extras for Y Level No. 19

	Code Word
Mirror to control bubble from eye end.....	CUPID
Stadia hairs fixed, set 1:100.....	CUPOLA
Reversion level to telescope with protection ring.....	CULTURE
Constructed with three leveling screws instead of four.....	CULVERIN
Silk protection bag (waterproof).....	CURTAIN
Full extension tripod in lieu of straight legs.....	CUMBRAANCE
Bottle of fine instrument oil.....	CUTEX
Inverting eye-piece (made to order only).....	CUTWATER

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS



No. 19G
LIETZ GEODETIC PRECISE LEVEL
Code Word, BUMBRAY

LIETZ GEODETIC PRECISE LEVEL No. 19G

With the Lietz Geodetic Precise Level quicker and more accurate results can be obtained than with the ordinary Wye or Dumpy Level.

The feature by which this is accomplished consists principally of a micrometer screw for the vertical control of one of the Ys. With this the telescope can be raised or lowered at the eye end with greater speed and accuracy than can be obtained with the leveling screws.

The Telescope is carefully pivoted, but can easily be relieved for testing of adjustments, which is done in the same manner as with the ordinary Wye Level. The collars are made of our special hard metal and are equalized with great care. A mirror is attached for control of the level bubble from the eye end of the Telescope. A circular level attached to the starpiece is for the purpose of leveling the instrument approximately. The final setting is accomplished with the micrometer screw for each reading.

It has been the custom generally to recommend and supply this type of instrument with three leveling screws and inverting Telescope, but late experience has proven that it is more practical and economical to adhere to the four leveling screws, as it enables the average instrument man to handle the instrument without the necessity of adapting himself to the manipulation of a system which is not of everyday use. With the development of our optics, we can furnish a highly satisfactory Telescope of the erecting type.

The Lietz Geodetic Precise Level will give excellent results and can be manipulated by the average instrument man with greater facility than the ordinary level. It will, therefore, replace the ordinary Wye and Dumpy Level in many instances, where the first cost is made subsidiary to economic efficiency.

Sensitiveness of level vial furnished is from ten to twenty seconds. We recommend fifteen seconds of arc, as this level can be readily set to any reading within two or three seconds of arc. This has been accomplished by careful grinding to the proper curvature, which together with the nature of the filament gives the bubble a free and rapid motion.

Dimensions and Weights

Length of telescope.....	18	inches
Diameter of objective.....	1 $\frac{3}{8}$	"
Magnifying power	33	×
Weight.....Instrument, 11 lbs.; tripod, about 8 $\frac{1}{2}$ lbs.; box, about 8 lbs.		

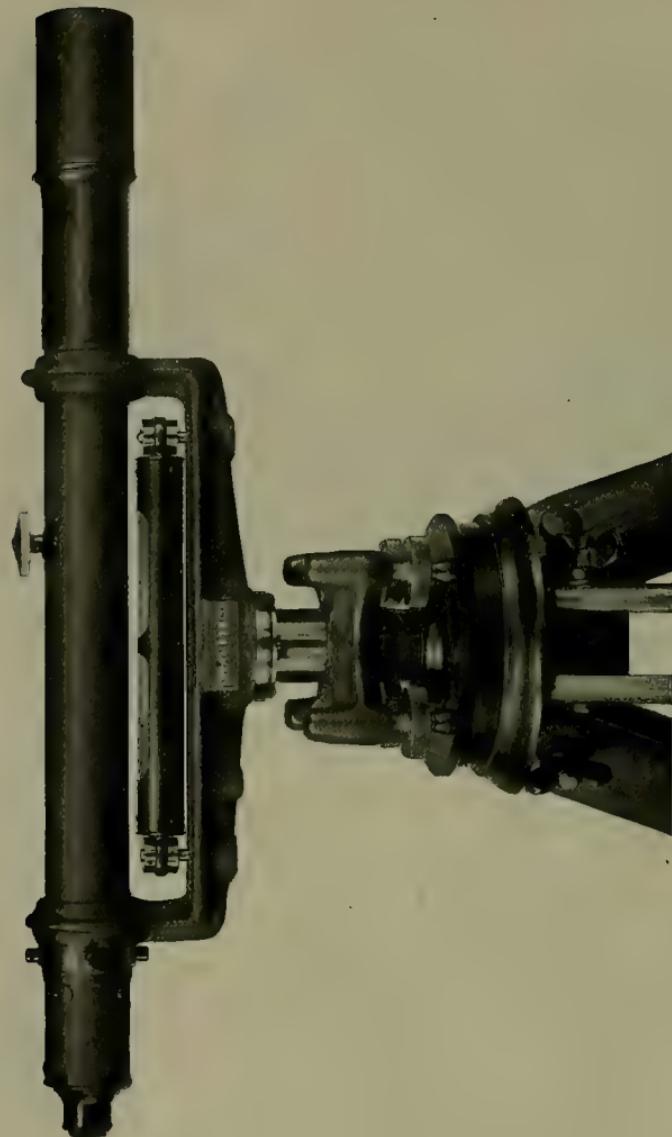
Instrument as Usually Furnished

- No. 19G. Lietz Geodetic Precise Level, equipped with split-leg tripod. Instrument complete with sunshade, dust brush, adjusting pins and all usual accessories, in polished mahogany box.
.....Code Word, **BUMBRAY**

For extras for Geodetic Precise Level see under No. 19, page 95.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS



No. 20

LIETZ ENGINEERS' DUMPY LEVEL

Code Word, **BUMPER**

No. 20T. Same as No. 20, but with clamp and tangent movement.
Code Word, **BURGESS**

LIETZ ENGINEERS' DUMPY LEVELS Nos. 20 to 20T

A rugged and compact instrument of great strength and permanency of adjustments. Greater stability has been secured with a reinforced bar of improved design and ribbed construction of the starpiece, without increasing the weight. Its simplicity and accuracy recommend it for the best class of engineering work and for use in rough country and under most severe conditions. Instrument sets low on the tripod, which is a desirable characteristic. Long center of our special hard alloy; sensitive spirit level. Telescope has definition, light and power in a high degree and is provided with slide protector.

Dimensions and Weights

Length of telescope.....	18 inches
Diameter of objective.....	1 3/8 "
Magnifying power	33 X
Weight.....Instrument, 10 lbs.; tripod, about 8 1/2 lbs.; box, about 8 lbs.	

Instruments as Usually Furnished

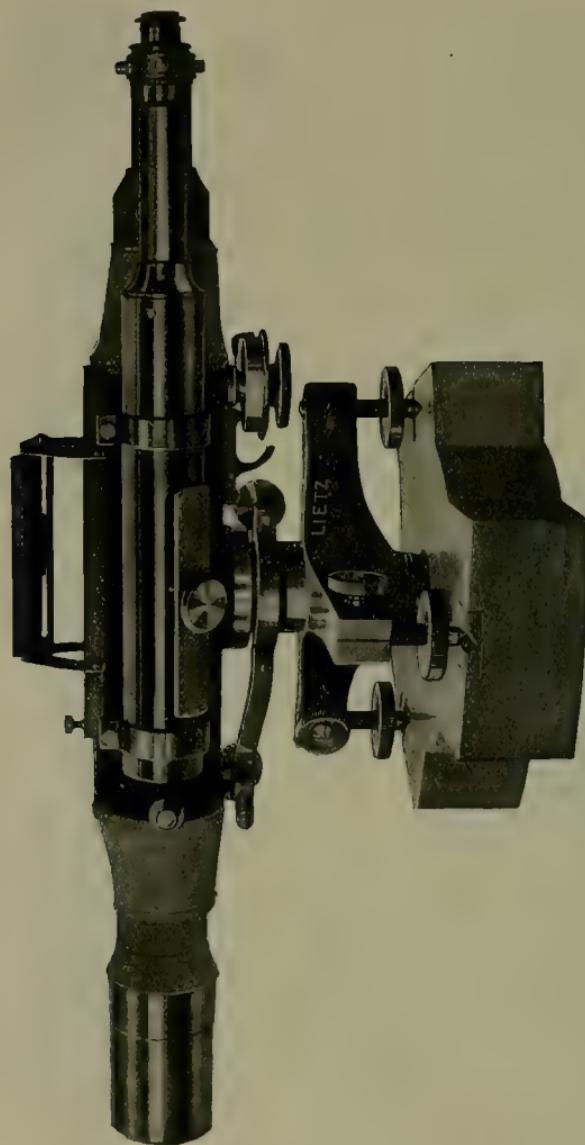
- No. 20.** Lietz Engineers' Dumpy Level, equipped with split-leg tripod. Instrument complete with sunshade, dust brush, adjusting pins and all usual accessories, in polished mahogany case.
.....Code Word, **BUMPER**
- No. 20T.** Same as No. 20 but fitted with clamp and tangent movement.
.....Code Word, **BURGESS**

Extras for Nos. 20 and 20T

	Code Word
Mirror to control bubble from eye end.....	CUPID
Stadia hairs fixed, set 1:100.....	CUPOLA
Constructed with three leveling screws instead of four.....	CULVERIN
Silk protection bag (waterproof).....	CURTAIN
Full extension tripod in lieu of straight legs.....	CUMBRANCE
Bottle of fine instrument oil.....	CUTEX
Inverting eye-piece (made to order only).....	CUTWATER

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS



No. 20G

LIETZ PRECISE LEVEL.

Design of the U. S. Coast and Geodetic Survey.
Code Word, **BURGUNDY**

MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS THE A. LIETZ COMPANY
SAN FRANCISCO, U. S. A.

LIETZ PRECISE LEVEL No. 20G

U. S. Coast and Geodetic Survey Design

The United States Coast and Geodetic Survey Precise Level is of the Dumpy Type, and is designed to meet the demand for an instrument whereby the greatest precision possible in leveling can be obtained. In the construction of this instrument we follow in every respect the specifications of the United States Coast and Geodetic Survey. The use of nickel iron, with coefficient of expansion of 0.000004 per degree Centigrade, in connection with nickel steel with coefficient of expansion of 0.000001 per degree Centigrade, assures of a permanency of adjustment of this instrument under decided changes of temperature. The instrument has a fixed adjustment between the line of collimation and the level. The level is set partially within the telescope and as near as possible to the line of collimation.

Specifications

TELESCOPE—17 inches long, inverting, magnifying power about 40 X, object glass, 1 $\frac{3}{4}$ inches diameter.

LEVEL TO TELESCOPE—5 $\frac{3}{4}$ inches long, chambered, graduated 2-mm. divisions; sensitiveness to 2" of arc.

STADIA HAIRS—Set 30 cm. to 100 meters.

MICROMETER SCREW—Has head divided into 100 parts, 100 revolutions to one inch, provided with cam for lifting telescope from micrometer screw when not in use.

WEIGHT—Instrument, about 14 lbs.; tripod, about 19 lbs.; box, about 16 lbs.

Code Word, **BURGUNDY**

See price list in back of catalog.

LIETZ IMPROVED BUILDERS' DUMPY LEVEL
No. 21



To meet the increasing demand for a high-grade instrument for the road builder, drainage engineer and building contractor we have constructed our improved Builders' Dumpy Level. It is similar in design and construction to our Engineers' Dumpy Level No. 20 but smaller in size, therefore lighter and more portable. Built along simple lines of our hard metal alloys, assuring of long wear and greatest efficiency in the field. Long center, sensitive spirit level, and a telescope possessing definition, light and power in a high degree, provided with slide protector.

Dimensions and Weights

Length of telescope.....	11 inches
Diameter of objective.....	1 $\frac{1}{8}$ "
Magnifying power	24 X
Weight.....Instrument, 5 $\frac{3}{4}$ lbs.; tripod, about 7 $\frac{1}{2}$ lbs.; box, about 5 lbs.	

Instruments as Usually Furnished

- No. 21. Lietz Improved Builders' Dumpy Level, equipped with split-leg tripod. Instrument complete with sunshade, dust brush, adjusting pins, etc., in neat polished mahogany case....Code Word, **BURROW**

EXTRAS

For which the additional charge is made. Kindly specify if desired.

Fixed stadia hairs set 1:100.....	Code Word CUPOLA
One extension tripod leg in lieu of straight leg.....	CURLY
Full extension tripod in lieu of straight leg.....	CUMBREANCE
Silk protection bag or hood (waterproof).....	CURTAIN
Bottle of fine instrument oil.....	CUTEX

See price list in back of catalog.

**LIETZ IMPROVED BUILDERS' DUMPY LEVEL
No. 21C**



This is the same Instrument as our No. 21 but equipped with horizontal circle and vernier reading to 5 minutes.

Instrument as Usually Furnished

No. 21C. Lietz Improved Builders' Dumpy Level, equipped with horizontal circle with vernier reading to 5 minutes, and split-leg tripod. Instrument complete with sunshade, dust brush, adjusting pins, etc., in neat polished mahogany case.....Code Word, **BURSAR**

For extras, see opposite page

A good instrument assures its owner of a lasting satisfaction, both in results obtained and as an investment.

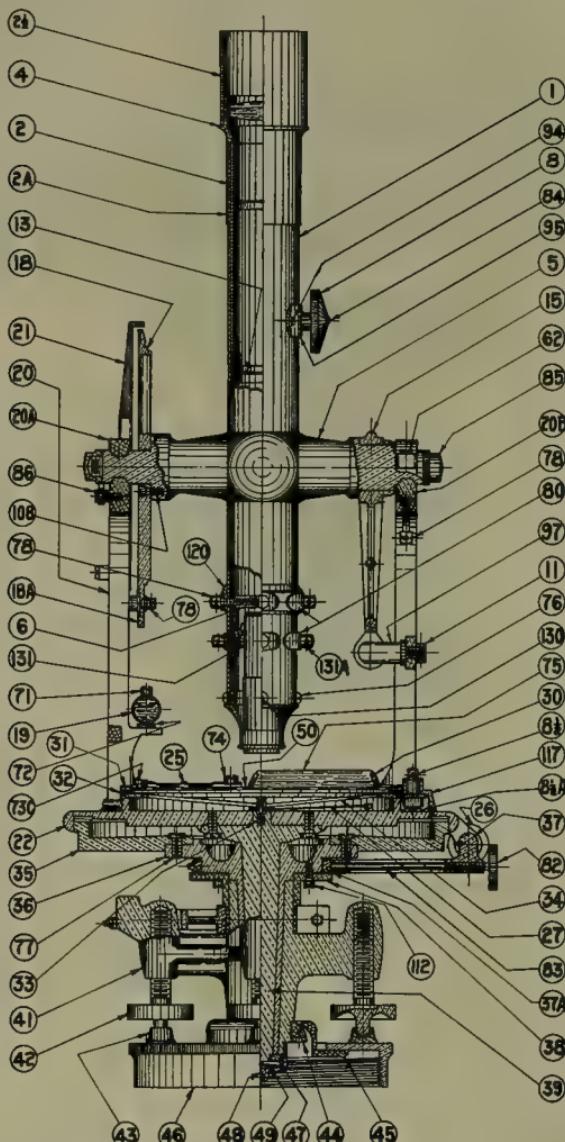
See price list in back of catalog.

THE A. LIETZ COMPANY

SAN FRANCISCO, U. S. A.

MODERN ENGINEERS' AND SURVEYORS' INSTRUMENTS

CROSS SECTION OF LIETZ TRANSIT



SUNDRIES FOR TRANSITS AND LEVELS.

Tempered Steel Adjusting Pins for instrument adjustments

Tempered Steel Adjusting Pins for instrument adjustments
Tempered Steel Adjusting Pins, large size for Y levels .

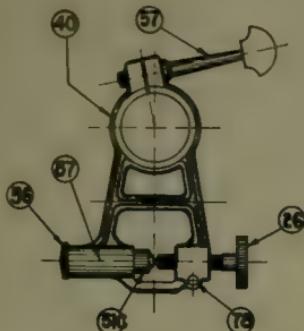
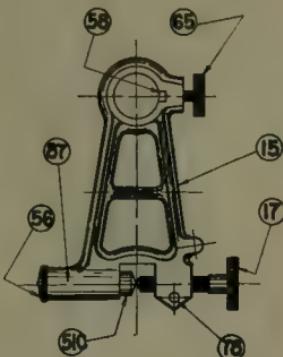
Tempered Steel Adjusting Pins, large size for 1" levels.
Phosphor Bronze Adjusting Pins for setting off variations.

Screw Driver for instrument box

Camel Hair Dust Brush for instruments

Enak

PARTS SUSCEPTIBLE TO LOSS OR INJURY

Piece 40 Lower Clamp
completePiece 15, Axis Clamp
complete

Please order part by piece number, giving serial number of instrument. It must be borne in mind that vital parts of Precision Instruments cannot be made interchangeable. It is therefore advisable to forward broken parts.

Piece No.	
2½.	Sunshade.
6.	Cross Hair Frame.
8.	Pinion Head.
15.	Axis Clamp complete.
17.	Tangent Screw.
18.	Vertical Circle.
19.	Standard Level Housing.
21.	Vertical Circle Guard.
25.	Plate Level Housing.
26.	Plate Tangent Screw.
30.	Vernier Shade Bracket.
30A.	Vernier Shade Bracket Screws.
31.	Shell for Compass Glass.
34.	Compass Needle.
37.	Plate Clamp complete.
38.	Collar.
40.	Lower Clamp complete.
42.	Leveling Screws.
43.	Leveling Screw Cups.
46.	Base Plate.
47.	Spindle Nut.

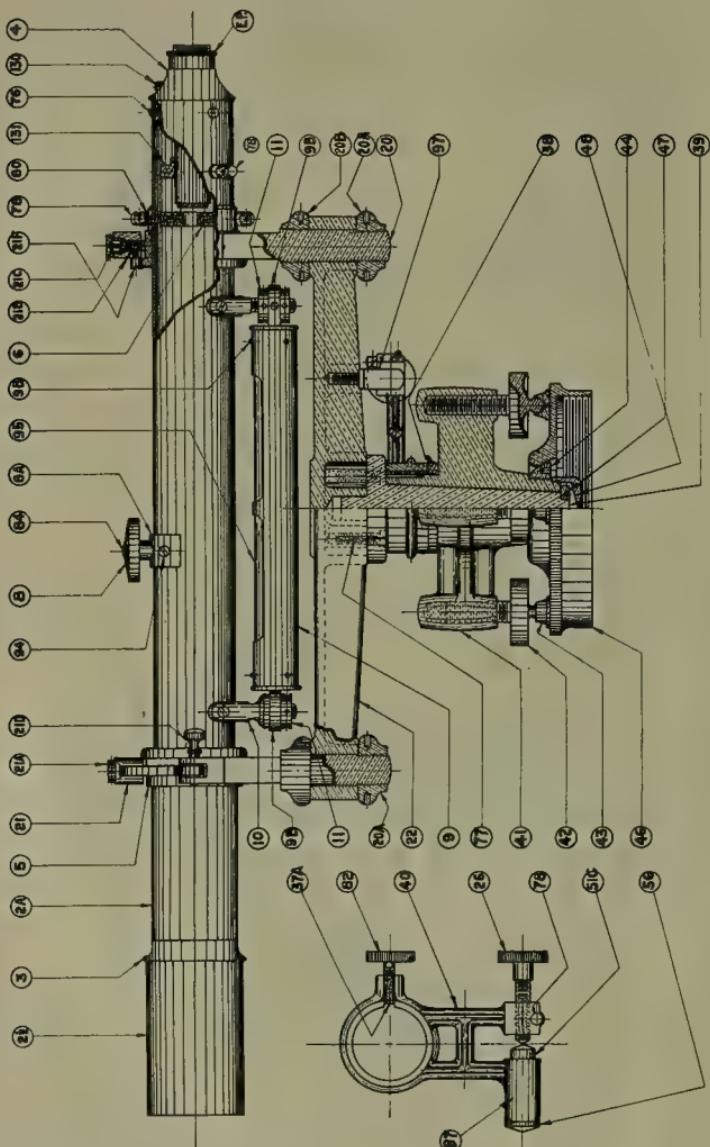
Piece No.	
48.	Plumbbob Cap.
49.	Spindle Release Spring.
50.	Compass Glass.
51B.	Plunger for Plate Tangent.
51C.	Plunger for Clamps.
56.	Cap for Clamps.
57.	Clamp Screw.
62.	Standard Cap Screw.
65.	Axis Clamp Screw.
75.	Shade Glasses.
82.	Plate Clamp Screw.
85.	Acorns for Axis.
86.	Guard Screws.
87.	Tangent Spring.
88.	Chain for Plumbbob.
89.	Vernier Cover Glasses.
90.	Dust Cap for Telescopes.
94.	Collet Fastening Screws.
95.	Collet.
112.	Collar Fastening Screws.
152.	Spanner Wrench.

INSTRUMENT BOXES AND ACCESSORIES

Each

New mahogany box with wooden fittings and strap complete for Transits Type 4 and 9	
New mahogany box with wooden fittings and strap complete for Levels Type 19 and 20	
New mahogany box with wooden fittings and strap complete for Transits Type 12	
New mahogany box with wooden fittings and strap complete for Levels Type 21	
Extra key for boxes	
New strap for boxes	
New bumpers for boxes	
New shipping boxes with carrying rope for transits and levels	

CROSS SECTION OF LIETZ LEVEL



PARTS OF LEVEL SUSCEPTIBLE TO LOSS OR INJURY

Kindly order by piece number, giving serial number of instrument. It must be borne in mind that vital parts of precision instruments cannot be made interchangeable. Needed screws are best ordered by sending broken portions.

Piece	
No. 1.	Telescope.
No. 2.	Slide.
No. 2A.	Slide protector.
No. 2 ¹ z.	Sun shade.
No. 3.	Objective head.
No. 4.	Eye-piece collar.
No. 5.	Telescope axis.
No. 6.	Cross Hair frame.
No. 8.	Pinion Head complete.
No. 8A.	Saddle.
No. 9.	Tel. level housing.
No. 9A.	Tel. level housing ends.
No. 9B.	Tel. level end fast screw.
No. 19.	Tel. level brackets.
No. 11.	Tel. level adjusting nuts.
No. 13.	Diaphragm (not shown).
No. 20.	Standards.
No. 20A.	Lower nuts to standard.
No. 20B.	Upper nuts to standard.
No. 21.	Clasp.
No. 21A.	Cap.
No. 21B.	Plunger.
No. 21C.	Plunger spring.
No. 21D.	Lock pins.
No. 21E.	Hinge pins (not shown).
No. 21F.	Stop pin to Telescope.
No. 22.	Bar.
No. 2.	Tangent screw.
No. 37A.	Clamp block.
No. 38.	Collar.
No. 39.	Spindle.
No. 40.	Lower clamp.
No. 41.	Starpiece.
No. 42.	Leveling screw.
No. 43.	Leveling screw cups.
No. 44.	Ball.
No. 45.	Baseplate.
No. 47.	Spindle nut.
No. 48.	Bottom cap.
No. 51C.	Plunger.
No. 56.	Plunger cap.
No. 76.	Eye-piece collar screw.
No. 77.	Bar fastening screw.
No. 78.	Cross Hair frame screw.
No. 80.	Cross Hair frame washer.
No. 82.	Plate clamp screw.
No. 84.	Pinion Head screw.
No. 87.	Spring not shown.
No. 90.	Dust cap.
No. 94.	Collet screw.
No. 95.	6" level vial.
No. 97.	Abutting piece.
No. 130.	Eye-piece focusing screw.
No. 131.	Eye-piece reinforcing ring.

LIETZ GRADUATED AND GROUND LEVEL VIALS



Prices of Level Vials Only, Without Housing

Level Vials for Telescopes of Transits and Levels. Per inch of length (unmounted)
Level Vials for Plate and Standard of Transits (unmounted).....
Circular Level Vial (as furnished with our Hydrographic Y Level and Alidades)

PLAIN LEVEL VIALS, NOT GRADUATED OR GROUND

Plain Level Vials, not graduated, 1 to 4 inches long, each.....
Plain Level Vials, not graduated, 4½ to 6 inches long, each.....

Housing for Lietz Level Vials

(Not including posts or nuts, etc.)

Housing for Telescope Levels for Mountain Transits.....
Housing for Telescope Levels for large Engineers' Transits.....
Housing for Telescope Levels for Dumpy and Y levels.....
Housing for Plate and Standard Levels for Transits.....

For replacing broken level vials we suggest the sending of the housing for which the level vial is intended to insure proper size.
Extra for mounting any size.....

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

LIETZ PLANE TABLE OUTFITS

The advantages of the Plane Table for topographic surveying and mapping are being more and more appreciated. The engineer, topographer and geologist can obtain maps more quickly and accurately than by the usual method of transit survey, for the reason that the essential locations and sketches are made directly in the field, eliminating the necessity of extensive field notes.

A drawing board, especially constructed for field use, and fitted with countersunk holding-down screws for drawing paper, is mounted on a tripod with a specially constructed head.

The Johnson Head consists of a ball and socket movement which permits of the orientation and quick leveling of the drawing board, and two wing nuts by means of which the board is securely clamped in position.

The Lietz Tangent Head is an improved form, and while it entails a somewhat greater investment, it is self-evident that its nicety of adjustment and control of the drawing board is a labor-saving feature. It is constructed with three leveling screws and a clamp and tangent movement.

Lietz Alidades are now made in several forms or modifications to meet the various requirements of the profession. They fill a long-felt want for a high-grade instrument of this kind. The telescope has definition, light and power in a high degree and revolves 180 degrees on its longitudinal axis for adjustment and control of the line of collimation. The vertical arc is graduated on the periphery and set at an angle for convenient reading of the vernier. The index of the vernier is at 30 instead of 0; therefore all angles as read are positive, eliminating the possibility of error in the notes. A recent improvement consists of a tangent movement to the vernier arm, which permits setting the vernier exactly at index when the telescope level is centered, irrespective of a possible slight tilt of the drawing board, and the subsequent reading of the vertical angle can be recorded directly by one reading of the arc.

The Striding Level is long and sensitive and has a neat snap arrangement for quickly attaching to the telescope. The collars on which it rests are made of our special hard alloy to insure of long wear. When not in use, the striding level is detached from the telescope and placed on the blade for safe and compact packing.

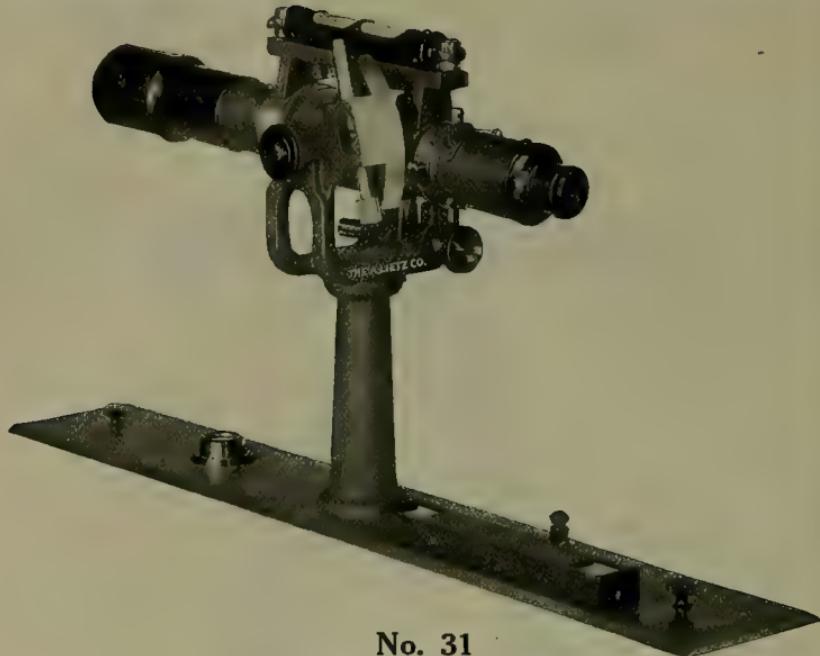
An improved form of trough compass may be mounted on the blade of the instrument or countersunk into the edge of the drawing board.

LIETZ PLANE TABLE OUTFITS



Lietz Plane Table Outfit consisting of No. 31 Alidade with trough compass No. 34A, No. 34B Lietz Tangent Head Tripod, No. 34F Drawing Board size 24x31 with holding-down thumbscrews, and No. 34L Plumbing Arm and Plummets.

For further description see pages 110 to 113.



No. 31

LIETZ ALIDADE

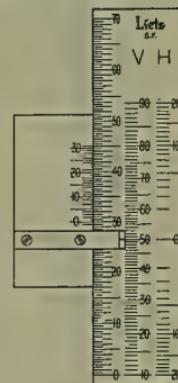
Standard type. 11-inch telescope, 18-inch blade. Fitted with
trough compass.

Alidade Code Word
Trough Compass CORDATE
DROUGHT

GRADUATIONS OF ARC AND VERNIER



Illustrating grad-
uation of vertical
arc, vernier read-
ing to minutes.



Illustrating grad-
uation of Beaman
stadia arc, vernier
reading to min-
utes.

LIETZ PRECISION ALIDADE No. 31

Dimensions and Weights

Length of telescope.....	11 inches
Diameter of objective.....	1 1/4 "
Magnifying power	24 X
Size of blade	18 inches long, 3 inches wide
Weight	About 7 lbs.

Specifications

No. 31. Lietz Precision Alidade with revolving telescope, 11 inches long, with clamp and tangent, Cross Hairs and Stadia Hairs fixed, set 1:100. Striding Level with snap arrangement for attaching to telescope. Vertical arc graduated on the periphery on solid silver with vernier reading to minutes, tangent movement to vernier arm; blade 18 inches long and 3 inches wide, finished on under side with white celluloid paint to prevent soiling of drawing paper and with circular spirit level. Instrument complete with sunshade, dust brush, adjusting pins and all usual accessories in polished mahogany box.

Code Word, **CORDATE**

Extras for Alidade No. 31

	Code Word
Prism to eye-piece with neutral glass, see page 69.....	CUMBERSOME
Gradienter attachment to vertical motion with movable head.....	CULPABLE
Level attached to vernier arm for control of zero on vernier.....	DIAGNOSE
Trough compass mounted on blade.....	DROUGHT
Quarter hair in upper field.....	DIALECT
Parallel straightedge attachment to blade.....	DIALOGUE
Beaman stadia arc.....	DIAMOND
Inverting eye-piece (made to order only).....	CUTWATER

Parts susceptible to loss or breakage

Extra striding level complete.....	DIBBER
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For level vial only see page 107.

Extra circular spirit level for blade.....	DICKY
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See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

LIETZ PLANE TABLE OUTFITS



No. 34B

**LIETZ TANGENT HEAD TRIPOD WITH STRAIGHT
LEGS AND HOOD**

Weight with hood about 19 lbs.
Code Word, **DEMOLISH**



No. 34C

**LIETZ JOHNSON HEAD TRIPOD WITH STRAIGHT
LEGS AND HOOD**

Weight with hood about 11 lbs.
Code Word, **DEMON**

LIETZ PLANE TABLE OUTFITS

Code Word

No. 34B.	Lietz tangent head tripod with straight legs.....	DEMOLISH
No. 34BE.	Lietz tangent head tripod with extension legs....	DENDRITE
No. 34C.	Johnson head tripod with straight legs.....	DEMON
No. 34CE.	Johnson head tripod with extension legs.....	DENDROID
No. 34F.	Drawing board with holding-down screws for paper and flange for mounting on tripod, size 24x31 inches	DRAFTING
No. 34FF.	Same as No. 34F but size 18x24 inches.....	DRAGON
No. 34H.	Same as No. 34F but size 15x15 inches.....	DRAWN
No. 34J.	Canvas carrying case with leather corners for drawing board 24x31.....	DREDGE
No. 34JJ.	Canvas carrying case with leather corners for drawing board 18x24.....	DRIBLET
No. 34K.	Canvas carrying case with leather corners for drawing board 15x15.....	DRIFTAGE
No. 34L.	Plumbing arm and plummet.....	DROPPED
No. 34M.	Fine quality drawing paper, white*, cream or green (specify color); size 24x31 inches, single mounted	DRYAD
No. 34N.	Fine quality drawing paper, white*, cream or green (specify color); size 24x31 inches, double mounted, muslin between, can be used on both sides	DRYDOCK
No. 34MM.	Single mounted drawing paper like No. 34M but size 18x24 or 15x15 (specify color).....	DRYING
No. 34NN.	Double mounted drawing paper like No. 34N but size 18x24 or 15x15 (specify color).....	DRYSALT
On special order we will supply drawing board size 22x22 and paper to fit at the same prices as size 18x24 (made to order only).....	DRYWARD	
*White paper can be furnished with Eggshell surface. If desired, specify "EGGSHELL"	EGGSHELL	

Parts Susceptible to Loss or Injury

Extra leather hood for tripod heads.....	DUALIST
Wing nuts for Johnson head.....	DUBLING
Leveling screws for tangent head.....	DUCAL
Screws for attaching board to tangent head.....	DUCKING
Holding-down screw and socket for drawing board.....	DUCTILE
Holding-down screw only.....	DUDEEN
Extra straight leg for tripod (Johnson or tangent head)....	DUENA
Extra extension leg for tripod (Johnson or tangent head)....	DUFFER

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS



No. 32
LIETZ ALIDADE

Stanford Geological type, 8½-inch telescope, 14-inch blade. Fitted with trough compass.

Code Word

Alidade	CORDWAIN
Trough Compass	DROUGHT



No. 32LC

Same as No. 32, but in leather carrying case instead of mahogany box.
Code word, **CORDWEIGHT**

LIETZ PRECISION ALIDADES Nos. 32 to 32LC
Stanford Geological Type

These instruments are of the same type and embody the same characteristics as our No. 31, but they are somewhat smaller in size. They are recommended for the best class of work, where a light, compact and portable instrument is desirable. The leather case, furnished with No. 32LC, is velvet lined and has shoulder strap, making an especially light and convenient means of carrying.

Dimensions and Weights

Length of telescope.....	8½ inches
Diameter of objective.....	1 inch
Magnifying power	18×
Size of blade	14 inches long, 3 inches wide
Weight	About 6 lbs.

Specifications

- No. 32.** Lietz Precision Alidade with revolving telescope, 8½ inches long, with clamp and tangent; cross hairs and stadia hairs fixed, set 1:100; striding level with snap arrangement for attaching to telescope; vertical arc graduated on the periphery on solid silver with vernier reading to minutes, tangent movement to vernier arm; blade 14 inches long and 3 inches wide, finished on under side with white celluloid paint to prevent soiling of drawing paper and with circular spirit level. Instrument complete with sunshade, dust brush, adjusting pins and all usual accessories in polished mahogany box.
.....Code Word, **CORDWAIN**
- No. 32LC.** Same as No. 32, but in strong compact leather carrying case with shoulder strap instead of mahogany case, with all accessories neatly fittedCode Word, **CORDWEIGHT**

Extras for Nos. 32 to 32LC

	Code Word
Prism to eye-piece with neutral glass, see page 69.....	CUMBERSOME
Gradienter attachment to vertical motion with movable head..	CULPABLE
Level attached to vernier arm for control of zero on vernier..	DIAGNOSE
Trough compass mounted on blade.....	DROUGHT
Quarter hair in upper field.....	DIALECT
Parallel straight edge attachment to blade.....	DIALOGUE
Beaman stadia arc.....	DIAMOND
Inverting eye-piece (made to order only).....	CUTWATER

For parts susceptible to loss or breakage see page 111.

For tripods, boards and other accessories see page 113.

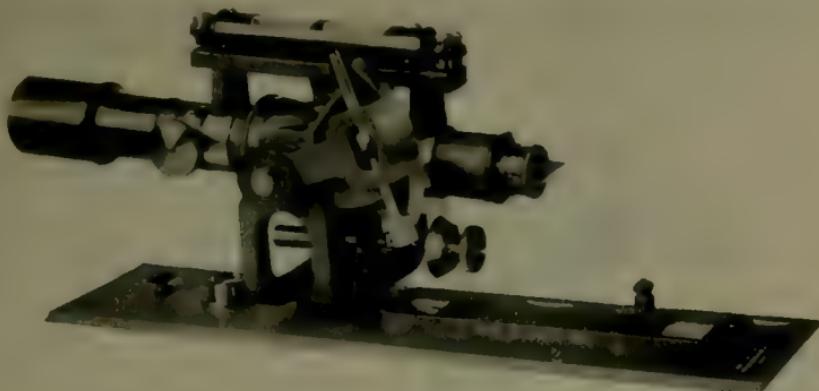
See price list in back of catalog.

LIETZ GEOLOGISTS' PLANE TABLE OUTFITS.



The Lietz Geologists' Alidade No. 33 was developed by us several years ago to meet the demand for an extra light and compact instrument. It met with instant favor, for its portability was obtained without sacrificing any of the desirable features found in our larger Alidades, and which are so necessary for quick and accurate results. The telescope is the same as that in our high-form Alidade No. 32, and possesses definition, light and power in a high degree. Fitted with prismatic eye-piece. The Striding Level has a snap arrangement for quickly attaching to the telescope and the spirit level is long and sensitive. The gradienter screw with movable head and our improved trough compass are standard equipment with this instrument; the blade is beveled on both sides and the right edge is graduated to inches, 10ths and 50ths. Today this instrument is the standard of equipment with many of our largest users, and especially in our Mid-Continent oilfields and in California.

The Lietz Special Light-Weight Johnson Head Tripod used in connection with this instrument has extension legs and weighs only six pounds.



No. 33

LIETZ GEOLOGISTS' ALIDADECode Word, **CORIANDER****Dimensions and Weights**

Length of telescope.....	8½ inches
Diameter of objective.....	1 inch
Magnifying power	18 X
Size of blade.....	12 inches long, 3 inches wide
Weight	About 5 lbs.

Specifications

- No. 33.** Lietz Geologists' Alidade with revolving telescope 8½ inches long with clamp and tangent and gradiometer screw to vertical movement; cross hairs and stadia hairs fixed, set 1:100; prism to eye-piece; striding level with snap arrangement for attaching to telescope; vertical arc graduated on the periphery on solid silver with vernier reading to minutes, tangent movement to vernier arm; blade 12 inches long and 3 inches wide, finished on under side with celluloid paint, beveled on both sides, the right edge graduated to inches, 10ths and 50ths, fitted with circular spirit level and trough compass and finger buttons for conveniently orienting alidade. Instrument complete with sunshade, dust brush, adjusting pins and all usual accessories in neat leather carrying case with shoulder sling.

Code Word, **CORIANDER****Extras for No. 33**

	Code Word
Level attached to vernier arm for control of zero on vernier.	DIAGNOSE
Quarter hair in upper field.....	DIALECT
Parallel straight edge attachment to blade.....	IALOGUE
Beaman stadia arc.....	DIAMOND
Inverting eye-piece (made to order only).....	CUTWATER
For parts susceptible to loss or breakage see page 111.	
For tripod, boards and other accessories see page 118.	

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

**LIETZ SPECIAL LIGHT-WEIGHT JOHNSON PLANE
TABLE MOVEMENT AND EXTRAS FOR
PLANE TABLE OUTFITS**



	Code Word
No. 34½CE. Lietz Special Light-Weight Johnson Head Tripod with extension legs.....	DENTARY
No. 34½CEC. Canvas carrying case with leather ends for tripod No. 34½CE.....	DERBY
No. 34½CEH. Leather protection hood for No. 34½CE.....	DERMIC
No. 34FF. Drawing board with holding-down screws for paper and flange for mounting on tripod. Size 18x24 inches	DRAGON
No. 34H. Same as No. 34FF but size 15x15 inches.....	DRAWN
No. 34JJ. Canvas carrying case with leather corners for drawing board 18x24	DRIBLET
No. 34K. Canvas carrying case with leather corners for drawing board 15x15.....	DRIFTAGE

For Drawing Paper see page 113.

See price list in back of catalog.

LIETZ SIGHT ALIDADES



No. 35½

- No. 35½.** Lietz Pocket Sight Alidade, straight edge 10 inches long, one edge beveled graduated 40 parts to the inch. Folding fore and back sights, 3½ inches high. In sewed leather pocket case.....
.....Code Word, **CORMORANT**

LIETZ TRAVERSE TABLES

The Lietz Traverse Tables are light and portable and very simple in construction. The tripod is similar to our light-weight Johnson Head Outfit, but instead of the Johnson Head, the drawing board is mounted on a simple metal swiveling arrangement, which permits of orientation and clamping. The extension legs permit of a quick set-up in the field and make the tripod light and compact for transportation. The drawing boards are similar to those furnished with our Plane Table Outfits and can be furnished with trough compass inserted in one edge.

Code Word

- No. 36A.** Traverse table tripod with metal clamping and swiveling arrangement for attaching drawing board, fitted with light extension legs.....
.....**CORONAL**
- No. 36C.** Canvas carrying case with leather ends for tripod No. 36A
.....**CORRIDOR**
- No. 34H.** Drawing board with flange for mounting on tripod, and holding-down screws for paper, size 15x15
.....**DRAWN**
- No. 34K.** Canvas carrying case with leather corners for drawing board 15x15.....
.....**DRIFTAGE**
- No. 34A.** Trough compass fitted in one edge of drawing board
- No. 34MM.** Single mounted drawing paper, white*, cream or green (specify color); size 15x15.....
.....**DRYING**
- No. 34NN.** Double mounted drawing paper, white*, cream or green (specify color); size 15x15.....
.....**DRYSALT**
- *White paper can be furnished with eggshell surface. If desired, specify "EGGSHELL".....
.....**EGGSHELL**

See price list in back of catalog.

TRIPODS FOR LIETZ INSTRUMENTS



Made of selected straight-grained hardwood, well seasoned. Tripod heads are cast of our bell metal and fitted with aluminum protection caps. Shoes fitted with offset for pressing same more securely into the ground.

Our split-leg tripods are so designed and constructed as to secure the greatest amount of steadiness and strength with the least amount of weight. We can furnish these tripods with one extension leg. This admits of all the advantages of the extension tripod as regards set-ups, with, of course, the disadvantage of being less portable.

Our Extension Tripods are very rigid and strong. The double clamps employed act quickly and firmly. They are made of special drawn hard metal and will not break or bend under ordinary use.

MODERN ENGINEERS' AND SURVEYORS' INSTRUMENTS THE A. LIETZ COMPANY
SAN FRANCISCO, U. S. A.

TRIPODS FOR TRANSITS AND LEVELS

	Code Word
No. 38S. Standard Split-Leg Tripod for Transits Nos. 1 to 5F	EAGLET
No. 38L. Lightweight Split-Leg Tripod for Transits Nos. 7 to 14C	EARING
No. 39S. Standard Extension Tripod for Transits Nos. 1 to 5F	EARLDOM
No. 39L. Lightweight Extension Tripod for Transits Nos. 7 to 14C	EARTHY

TRIPODS FOR LEVELS

Our Engineers' Y Levels Nos. 19 to 19G and Dumpy Levels Nos. 20 to 20T will fit and interchange with tripods used for our Transits Nos. 1 to 5F.

Our Improved Builders' Dumpy Levels Nos. 21 to 21C will fit and interchange with tripods used for our Transits Nos. 7 to 14C.

Separate Legs for Tripods

Set of 3 Each

No. 038S. Separate Standard Split-Leg for Tripod No. 38S..	
No. 038L. Separate Lightweight Split-Leg for Tripod No. 38L	
No. 039S. Separate Standard Extension Leg for Tripod No. 39S	
No. 039L. Separate Lightweight Extension Leg for Tripod No. 39L	
No. 041CE. Separate Special Lightweight Extension Leg for Special Johnson Head Tripod No. 34½CE.....	

Plane Table Tripods and Extra Legs for same are listed on page 113.

Extras for Tripod Legs

Each

No. 042A. Round or Lower Portion of Extension Leg with shoe....	
No. 042B. Complete Upper Half of Extension Leg, consisting of two shells and clamps.....	
No. 042C. One Side or Shell of Upper Half of Extension Leg only..	
No. 042D. Extra Clamp complete with wing bolt.....	
No. 042E. Inner Ring of Extension Tripod Leg.....	
No. 042F. Extra Wing Bolt only for Clamp.....	
No. 042G. Extra Shoe with screws to attach.....	

Tripod Head

Each

No. 43. Tripod Head complete with bolts, nuts and washers (Tripod cap not included)	
No. 043A. Cast Aluminum Cap for Tripod.....	
No. 043B. Extra Bolt with wing nut and washer.....	
No. 043C. Extra Wing Nut and Washer for bolt only.....	

CARRYING CASES FOR TRIPODS

Made of Heavy Canvas with Leather Ends and Shoulder Strap.

Each

No. 44A. Carrying Case for Split-Leg Tripods.....	
No. 44B. Carrying Case for Extension Tripods.....	

See price list in back of catalog.

AGRICULTURAL LEVELS Nos. 46 and 46½



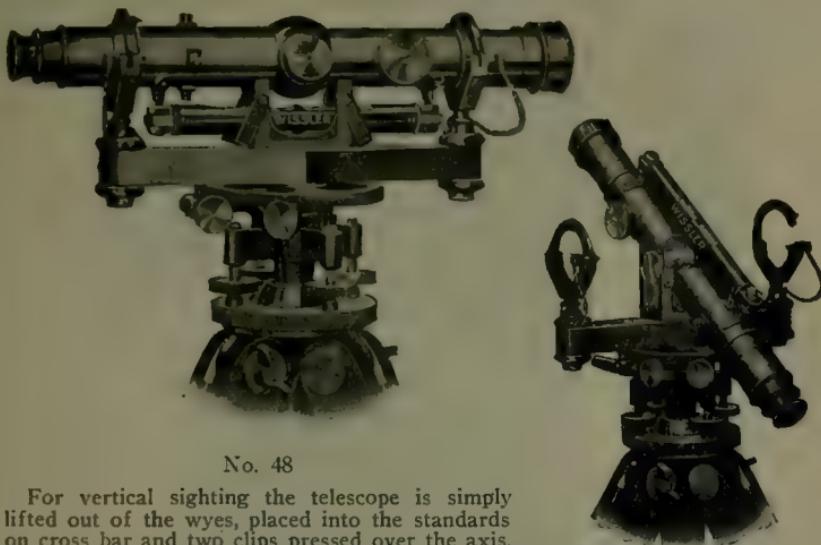
No. 46½

No. 46. Agricultural Level, Dumpy Type, with 12-inch telescope, magnifying power 24 diameters with cross hairs, 3½-inch horizontal circle with vernier reading to 5 minutes. Instrument equipped with split-leg tripod. Complete in neat mahogany finished case with all usual accessories Code Word, **EAPONITE**

No. 46½. Agricultural Level, similar to No. 46 but of lighter construction, with 10-inch telescope, magnifying power 15 diameters with cross hairs; 4-inch horizontal circle with vernier reading to 5 minutes. Shifting center. Instrument equipped with split-leg tripod. Complete with all usual accessories, in neat mahogany finished case. Code Word, **EBURINE**

See price list in back of catalog.

CONVERTIBLE BUILDERS' LEVEL



No. 48

For vertical sighting the telescope is simply lifted out of the wyes, placed into the standards on cross bar and two clips pressed over the axis.

- No. 48.** Convertible Builders' Level with 12-inch telescope, magnifying power 24 diameters with cross hairs; 3½-inch horizontal circle with vernier reading to 5 minutes. Instrument equipped with split-leg tripod. Complete with metal trivet plate, plumb bob, sunshade, adjusting pins and all usual accessories, in neat mahogany finished case.

.....Code Word, **E BYING**

SURVEYORS' UMBRELLAS



These Umbrellas are rattan ribbed so as not to deflect the compass needle. They are light and strong.

- No. 58.** Surveyors' Umbrella, heavy brown duck, rattan ribbed, about 6-foot spread, with tilting device; jointed handle 7 feet long with metal spear point.

.....Code Word, **E CHELON**

- No. 59.** Same as No. 58 but without tilting device.
.....Code Word, **E CHINATE**

See price list in back of catalog.

SEXTANTS



No. 65

- No. 65.** High-grade Sextant, 6½-inch radius, one-piece frame, gun-metal finish. Graduated on solid silver with vernier reading to 10 seconds. Telescopes (outside cell type) consist of high and low power inverting, achromatic star, blank, 2 dark heads, cone fitting. All telescopes have interrupted threads. Shades and neutral tint. Instrument complete with usual accessories in polished hardwood case.
.....Code Word, **EDGETOOL**
- No. 66.** High-grade Sextant like No. 65, but 8-inch radius. Instrument complete with usual accessories in polished hardwood case.
.....Code Word, **EDICTOR**

See price list in back of catalog.

POCKET MAGNIFYING GLASSES

Suitable for Reading Verniers, etc.



No. 70A



No. 71



No. 74

No. 70.	1-inch Single Lens, hard rubber, oval, magnification 4.0X			
No. 70A.	1½-inch Single Lens, hard rubber, oval, magnification 3.5X			
No. 70B.	1½-inch Single Lens, hard rubber, oval, magnification 3.0X			
No. 71.	1½-inch Double Lens, hard rubber, oval, magnification 3.5-7X			
No. 74.	1-inch Single Lens, hard rubber, bellows shape, magnification 4.0X			Each

Metal Mounting

No. 75.	1½-inch Single Lens, metal mounting, bellows shape, magnification 3.5X			
No. 76.	1½-inch Double Lens, metal mounting, bellows shape, magnification 3-6X			



No. 80



No. 81



No. 84

Each

No. 77.	Lietz Special Mining Loupe, 1¾-inch diameter, nickel plated folding frame, magnification 4.5X			
No. 78.	Coddington Lens, ½-inch diameter, nickel plated folding frame, magnification 20X			
No. 79.	Coddington Lens, ¾-inch diameter, nickel plated folding frame, magnification 10X			
No. 80.	Coddington Lens, 1-inch diameter, nickel plated folding frame, magnification 7X			
No. 79H.	Hastings Aplanatic Triplet, ½-inch diameter, nickel plated folding frame, magnification 10X			
No. 81.	Thread Counter, brass frame, ½-inch field			
No. 83.	Thread Counter, brass frame, nickel plated, 1-inch field			
No. 84.	Magnifier on three legs, brass, screw adjustment, 1-inch diameter, magnification 7.5X			

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

MAGNIFYING OR READING GLASSES

Reading Glasses Nos. 85 to 91 are of the best quality material and workmanship. The lenses are double convex, accurately ground from clear white glass and highly polished, mounted in German silver rim, with ebonized handle.



Nos. 85-91

	Each		Each
No. 85.	2 inches diameter.	No. 89.	4 inches diameter.
No. 86.	2½ inches diameter.	No. 90.	4½ inches diameter.
No. 87.	3 inches diameter.	No. 91.	5 inches diameter.
No. 88.	3½ inches diameter.		

MAGNIFYING AMOPTOSCOPES

In Leather Cases

Amoptoscopes are a new style of reading glass of the finest finish, workmanship and design. The lenses are of fine quality white glass fitted in narrow nickeled frames.



Nos. 95-96

	Each
No. 95. 2 inches diameter, in seal grain leather case.....
No. 96. 3 inches diameter, in seal grain leather case.....

See price list in back of catalog.

DIMINISHING OR REDUCING GLASSES

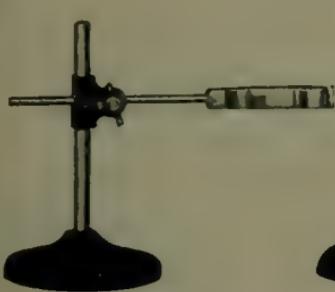
Reducing Glasses consist of double concaved lenses. Used by artists, engravers, etc., to reduce, optically, drawings, photographs and other illustrations.



Nos. 104-106

Each

- No. 100.** Reducing Glasses, round, rough edges, unmounted, $1\frac{1}{2}$ inches in diameter
- No. 101.** Reducing Glasses, round, ground edges, unmounted, 2 inches in diameter
- No. 103.** Reducing Glasses, in hard rubber case like Nos. 70-71 Magnifying Glasses, $1\frac{1}{2}$ inches in diameter.....
- No. 104.** Reducing Glasses, in German silver rim with ebonized handle, 2 inches in diameter.....
- No. 105.** Reducing Glasses, like No. 104, but 3 inches in diameter.....
- No. 106.** Reducing Glasses, like No. 104, but 4 inches in diameter.....

READING GLASS HOLDERS

No. 107



No. 108

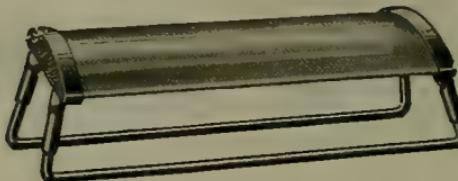
Each

- No. 107.** Reading Glass Holder, metal base $3\frac{1}{8}$ inches in diameter, $6\frac{1}{4}$ inches high. The lens arm is of one piece with spring clamp end, which will hold any lens not over $1\frac{1}{2}$ inches in diameter. Vertical and lateral adjustments.....
- No. 107A.** Same as No. 107, but with socket end in place of the spring clamp end, to accommodate Reading Glasses Nos. 85-92 or Reducing Glasses Nos. 104-105, after removing the ebonized handle.....
- No. 108.** Reading Glass Holder, metal base $4\frac{3}{4}$ inches in diameter, round metal pillar measuring $3\frac{1}{8}$ inches to the top. The lens arm is in three parts, with three joints, attached to a triangular post by a strong joint with broad bearing surface. The spring clamp will hold lenses not exceeding $1\frac{1}{2}$ inches in diameter. Adjustment is by rack and pinion.....
- No. 108A.** Same as No. 108, but with socket end in place of the spring clamp end, to accommodate Reading Glasses Nos. 85-92 or Reducing Glasses Nos. 104-105, after removing the ebonized handle

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

EASYREAD MAGNIFYING GLASSES



No. 109

A new line of Reading Glasses. Nickel mountings. Always in focus.

Each

No. 109. Reading Glass, 4x1 $\frac{1}{8}$ inches, folding, in leather case.....

No. 110A. Reading Glass, 5x2 $\frac{3}{4}$ inches, not folding.....

No. 110B. Reading Glass, 7x2 $\frac{3}{4}$ inches, not folding.....



No. 112

PRISMATIC RANGE FINDER

No. 112. Prismatic Range Finder. After sighting an object, the distance to which is to be measured, the shutter is shifted, either left or right (depending on the convenience of pacing distance). The distance walked along the base line until the same object is again brought into view multiplied by a constant of 50 will determine the distance sought. In leather case with directions.

.....Code Word, **EDUCATING**



No. 117

ANGLE PRISM

No. 117. Rectangular Prism, for angles of 90 degrees. Size of instrument 2 $\frac{1}{2}$ x1 $\frac{1}{4}$ x $\frac{5}{8}$ inches, in morocco case, each

Code Word, **EDUCATION**

See price list in back of catalog.

TALLY REGISTERS



No. 126A



No. 127A



No. 129

Hand Tally Registers Nos. 126-128, for keeping count by pressing on a knob, are of first-class workmanship and will not get out of order. The cases are nickel-plated and they are arranged with a zero-setting device. Each

No. 126A. Hand Tally Register, capacity 1 to 1,000..... Each

No. 126B. Hand Tally Register, capacity 1 to 10,000.....

No. 127A. Hand Tally Register with Safety Pin, capacity 1 to 1,000.

No. 127B. Hand Tally Register with Safety Pin, capacity 1 to 10,000.

DOUBLE TALLY REGISTER

Each

No. 128. Lietz Special Combined Tally Register, consisting of two No. 126A Registers joined as one, for tallying various timbers, etc., at one time

CELLULOID FIELD BOOKS OR CRUISERS' PADS

As used by woodsmen for tallying timber.

Cruisers' Pads contain six sheets of heavy white, opaque celluloid, dull finish, with strong leather covers. Will take pencil and erasures instantly. Not affected by rain.

Each

No. 129A. Cruisers' Pad, 4x6 inches, each.....

No. 129B. Cruisers' Pad, 5x6 inches, each.....

TIMBER SCRIBES



No. 130

Each

No. 130. Timber Scribe, wooden handle (size 6½ inches), each.....

NOTE—For special Circumference Tapes see page 191.

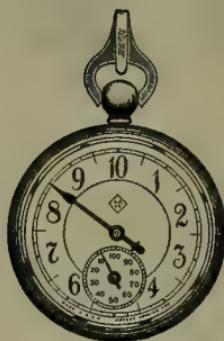
For Township Plats see page 215.

For Topographical Paper see page 216.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

PEDOMETERS AND PASSOMETERS



No. 132A



No. 138

PEDOMETERS

- No. 132A.** Pedometer, registers distance walked up to 100 miles by each one-quarter mile.....
The hands on above can be set backward or forward as desired by removing back of case and turning set screw.
- No. 135.** Pedometer, registers distance walked up to 100 miles by each one-quarter mile, with resetting device.....
- No. 136.** Pedometer, small size for ladies, $1\frac{1}{4}$ inches, registers 100 miles by single miles, gunmetal case.....

Each

PASSOMETERS

- No. 138.** Passometer, or step-counter, registers to 100,000 steps with stem resetting device.....

Each

See price list in back of catalog.

SURVEYING COMPASSES



No. 140



No. 144A

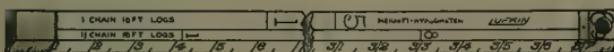
- No. 140.** Surveying Compass, with folding sights, graduated to $\frac{1}{2}$ degrees on raised ring, variation plate, two level bubbles, ball joint and socket for Jacob's staff mountings, needle $3\frac{1}{2}$ inches long. Each Code Word **EFFECTOR**
- No. 141.** Same as No. 140, but with $4\frac{1}{2}$ -inch needle. Each... **EFFECTUAL**
- No. 140LC.** Same as No. 140 in leather case with shoulder strap. **EFFICO**
- No. 141LC.** Same as No. 141 in leather case with shoulder strap **EFFIGY**

Extra Parts for Surveying Compasses Each

- No. 144A.** Leather Case for surveying compass, with shoulder strap...
No. 144C. Ball and Socket for surveying compass.....
No. 144D. Needle for surveying compass.....

Jacob's Staffs and Tripods for Compasses

- No. 146.** Jacob's Staff, 5 feet, iron shoe..... Code Word **EFFERENT**
No. 147. Tripod with Jacob's staff top for compasses..... **EFFERO**
No. 148. Tripod with brass staff top for compasses..... **EFFETE**

BILTMORE STICK

- No. 149.** Biltmore Stick used in reconnaissance estimates of timber tracts. Each

See price list in back of catalog.

CRUISERS' BOX COMPASSES



Nos. 150-150A

No. 150. Box Compass, 3x3 inches, with hinged cover with sight line, 2-inch needle, graduated on raised metal ring from 0-360....
No. 150A. Same as No. 150, but graduated in quadrants.....

Each

MINERS' COMPASS OR DIPPING NEEDLE



No. 154

No. 154. Dipping Needle, Norwegian pattern, needle gimbaled, in velvet-lined case

Each

This instrument is a serviceable guide to the discovery and location of magnetic iron ore. The magnetic needle is carefully balanced in a gimbal frame. It must be held so suspended that the needle is in the plane of the magnetic meridian. After releasing the stop the needle will swing freely. This instrument can be used for locating pipe lines and iron inspection covers which may be covered out of sight. It will not, however, indicate the presence of gold or silver.

See price list in back of catalog.

POCKET COMPASSES

WATCH PATTERN COMPASSES



No. 156



No. 158



No. 159

Each

- No. 156.** Pocket Compass, white metal, open-face case, flat, jeweled needle $1\frac{1}{4}$ in. long, silvered metal dial. Needle stop in crown..
- No. 158.** Pocket Compass, white metal, open-face case, jeweled bar needle $1\frac{1}{4}$ in. long, white enameled dial. Needle stop in crown
- No. 159.** Same as No. 158, but Hunting case. Self-acting needle stop..
- No. 160.** Pocket Compass, white metal, open-face case. Dial $1\frac{1}{4}$ in., is of aluminum and floats instead of being fixed, enabling one to note all magnetic bearings at once, jeweled center. Stop in crown
- No. 161.** Same as No. 160, but Hunting case. Self-acting stop.....

COMPASSES WITH ILLUMINATED DIAL FOR NIGHT READING



No. 165

- No. 164.** Pocket Compass, white metal open-face case, floating aluminum dial $1\frac{1}{4}$ in., similar to our No. 160 Compass, but the "N" and "S" points of the dial are treated with a permanently luminous compound which enables one to read direction at night. Jeweled center, stop in crown.....

- No. 165.** Same as No. 164, but Hunting case. Self-acting needle stop.....

- No. 165G.** Same as No. 165, but in gold-filled Hunting case.....

Each

See price list in back of catalog.

SIGHT AND CLINOMETER COMPASSES



No. 167A



No. 169

Each

- No. 167A.** Pocket Sight Compass, watch pattern, with folding sights. Jeweled needle, self-acting stop, 2 in.....
No. 167B. Same as No. 167, but needle $2\frac{3}{8}$ in.....
No. 168. Pocket Sight Compass, same as No. 167B with clinometer
No. 169. Bronzed Pocket Compass, pull-off cover, folding sights, edge bar, jeweled needle, with stop. Graduations on raised ring; 2-in.
No. 169A. Same as No. 169, but $2\frac{1}{4}$ -in.



No. 170



No. 175

Each

- No. 170.** Clinometer Compass, nickel case, flat jeweled needle; 2 in. long, with stop. Graduated on raised ring to single degrees. Pull-out lever which serves to rest the instrument on base when used as a clinometer.....

PRISMATIC COMPASSES

- No. 175.** Improved Prismatic Surveying Compass, bronze finish brass case 3" in diameter, folding prism in slide for focusing, floating dial, jeweled center, folding sight with automatic stop, in leather sling case
- No. 175A.** Same as No. 175, but fitted with engine divided aluminum ring

See price list in back of catalog.

BRUNTON POCKET
TRANSITShowing Brunton Transit on Ball
and Socket Tripod Head No. 185C.

No. 183

Code Word
EGLANTO**No. 183.** Brunton Pocket Transit, graduated 0-360.....**No. 183A.** Brunton Pocket Transit, graduated in quadrants..

BRUNTON TRANSITS WITH ILLUMINATED DIAL

Especially adapted for night or underground work.

These instruments are similar to Nos. 183-183A, but are furnished with a graduated cover glass treated with a permanent luminous compound. The ends of the needle and the sights are likewise illuminated. The illuminated features do not interfere with the use of the instrument for accurate work in the daylight.

No. 184. Brunton Pocket Transit with illuminated dial on cover glass, illuminated needle and sights. Graduated 0-360.....Code Word, **EGOTIC**

NOTE—Illuminated dials on cover glass are graduated to 10 degrees only, as the luminous compound cannot practically be used for finer graduations.

ACCESSORIES FOR BRUNTON POCKET TRANSITS

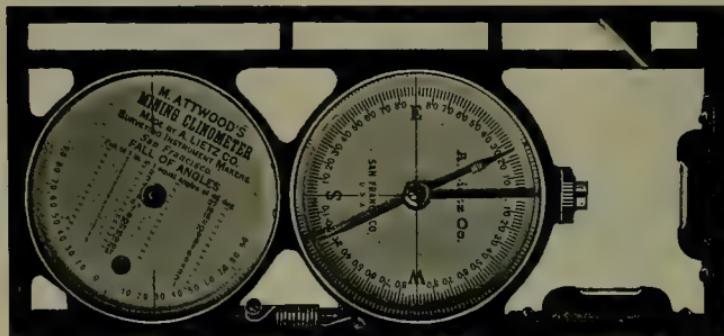
Code Word

No. 185A.	Leather case for Brunton Transit, with belt strap only.....	ELAND
No. 185B.	Leather case for Brunton Transit, with sling strap.....	ELAPSE
No. 185C.	Ball and Socket Tripod Head for Brunton Transit.....	ELASTIC
No. 185D.	Collapsible Metal Tripod for Brunton Transit.....	ELATE
No. 185E.	Level Bubble for Brunton Transit, loose.....	Each
No. 185F.	New Mirror for Brunton Transit.....	
No. 185G.	New Cover Glass for Brunton Transit.....	
No. 185H.	New wire ring to hold glass cover.....	
No. 185I.	New Needle for Brunton Transit.....	
No. 185J.	New Double Bubble Set.....	
No. 185K.	New Graduated Compass Ring.....	

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

**ATTWOOD'S MINING CLINOMETER AND
COMPASS**



No. 186

No. 186. Atwood's Mining Clinometer in leather case.

A universal measuring tool, combining a most sensitive clinometer, a compass, a hand level, and a horizontal and vertical contact level. Weight of instrument in genuine leather case eight ounces.

Code Word, **ELECTOR**

No. 187. Same as No. 186, but with graduations to the edges, which serve as a protractor; graduations to single degrees, also a scale 20 to 25 parts to the inch. In leather case..... Code Word, **ELECTIVE**

LIETZ HAND LEVELS



No. 190

No. 189. Lietz Special Hand Level, 5-inch, in sewed leather case. Finely finished and constructed, nickel-plated, with prism and magnifying lens to bubble, and drawout eye-piece..... Code Word, **ELECTRON**

No. 190. Lock's Hand Level, 5-inch, bronze finish, in leather case..... Code Word, **ELEGANT**

No. 191. Extra Leather Case for Nos. 189 and 190.



No. 192

No. 192. Square type combination hand and bench Level, 5-inch, in leather case..... Code Word, **ELEVATOR**

No. 193. Extra Leather Case for No. 192.....

See price list in back of catalog.

LIETZ HAND LEVELS AND CLINOMETERS



No. 195

No. 195.	Abney's model Combined Hand Level, Clinometer and Slope Measurer, 5-inch, arc graduated to degrees 0-90 in both directions with vernier reading to 10 minutes. Also a slope scale 1:1 to 1:10 reading each way. In leather case.....	Each
No. 195A.	Same as No. 195, but with arc graduated to degrees and with a per cent scale from 1 to 100%. U. S. Forest Service pattern. In leather case.....	Code Word, ELFFIRE
No. 196.	Extra Leather Case for Nos. 195 and 195A.....	Code Word, ELFLOCK

TOPOGRAPHIC ABNEY LEVEL



The Topographic Abney Level, as made by us for the U. S. Forest Service, is 6 inches long with 4-inch arc. Arcs can be obtained with various graduations and are interchangeable. Each instrument contained in leather case with belt strap.

No. 198.	Topographic Abney Level, arc in degrees.....	Code Word ELKBORN
No. 198A.	Topographic Abney Level, arc in per cent.....	ELKHEAD
No. 198B.	Topographic Abney Level, with topographic arc.....	ELKFORK
No. 199.	Extra arcs with any single graduation.....	ELKTON
No. 199A.	Extra arcs with any two graduations.....	ELKWOOD

EXTRA PARTS FOR HAND LEVELS

No. 197A.	Object Glass.....	Each
No. 197B.	Eye-piece Glass	
No. 197C.	Prism	
No. 197D.	Half-lens	
No. 197E.	Level Bubble, unmounted.....	

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

ANEROID BAROMETERS

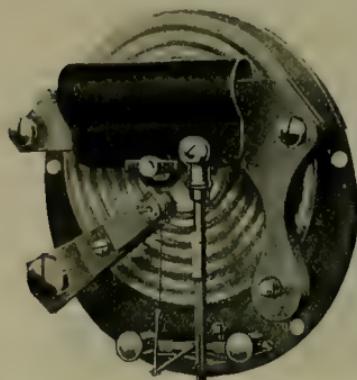
In connection with our line of Barometers, Barographs, Thermographs, etc., we desire to call attention to the importance of selecting such articles. We aim to carry only the most reputable makes of these instruments.

With our factory facilities and years of experience we are in a position to offer our patrons the accommodation of testing each individual instrument under pressure and in connection with a standard mercurial barometer, thus assuring our friends of that satisfaction seldom enjoyed when purchasing through other sources.

DESCRIPTION

The Aneroid, owing to its portable form and great sensitiveness in responding to changes in pressure of the atmosphere (it will denote a change much quicker than the Mercurial Barometer), is today in more general use by observers of meteorological changes than any other form of Barometer.

In measuring altitudes, owing to its portability, sensitiveness and the ease with which approximate results may be obtained, it is highly valuable to the Engineer and Surveyor, while the Tourist, with the Aneroid, notes his gain in elevation foot by foot, as well as plans his excursions in accordance with prognostications from its readings.



To the bridge is fixed the mainspring, which is forced down by mechanical means sufficient to insert a knife edge piece.

As this knife edge is fastened (by means of a central pillar) to the top disc of the chamber the mainspring, when released, lifts the upper part of the chamber, drawing the two discs apart.

As this forms a perfect balance (the power of the mainspring opposing the atmospheric pressure upon the vacuum chamber), any variation in air pressure will now be shown by a movement up or down of the elastic chamber. A decrease in pressure will allow the mainspring to overcome the power of the vacuum, the action then being upwards, and an increase of air pressure will produce the contrary result.

BOOKS ON THE BAROMETER

- "The Aneroid Barometer—Its Construction and Use," by George W. Plympton, A. M., C. E.
"The Barometer as the Foot Rule of the Air," by P. R. Jameson, F. R. Met. Soc.

See price list in back of catalog.

**FIRST QUALITY WATCH FORM ANEROID
BAROMETERS**

- No. 200** Gilt Case, open face, 1 $\frac{3}{4}$ -in., silvered metal dial with altitude scale 3000 feet in 10-ft. divisions. Compensated for temperature. In velvet-lined morocco case.....Code Word, **EPACT**
- No. 200C.** Same as No. 200, but 8000 feet. Altitude scale in 50-foot divisions. In velvet-lined morocco case.....Code Word, **EPAULET**
- No. 200D.** Same as No. 200, but 10,000 feet. Altitude scale in 100-foot divisions. In velvet-lined morocco case..Code Word, **EPHOD**
- No. 200E.** Same as No. 200, but 12,000 feet. Altitude scale in 100-foot divisions. In velvet-lined morocco case.....Code Word, **EPICURE**

SECOND QUALITY WATCH FORM ANEROID BAROMETERS

- No. 202C.** Same pattern as No. 200, compensated for temperature, silvered metal dial, with altitude scale to 8000 feet in 100-foot divisions.Code Word, **EPIDILE**
- No. 202E.** Same as No. 202C, but 12,000 feet. Altitude scale in 100-foot divisionsCode Word, **EPIGRAM**

ANEROID BAROMETERS IN METRIC DIVISIONS

For our export trade we carry the above Aneroid Barometers registering in the metric system at corresponding prices.

See price list in back of catalog.

POCKET SIZE ANEROIDS

Best Quality



Showing Pocket Aneroid No. 205A in Lietz Special Leather Case No. 206D,
as adopted by timber cruisers.

This is a most suitable instrument for the engineer and timber cruiser
and for all reconnaissance purposes.

Code Word

No. 205.	Pocket Size Aneroid, 2½ inches, gilt case. Compensated for temperature, silvered metal dial with altitude scale 3000 ft. in 10-ft. di- visions, in velvet-lined morocco case.....	EPILOGUE
No. 205A.	Same as No. 205, but 5000-ft. altitude scale in 20-ft. divisions, in velvet-lined morocco case....	EPIMORE
No. 205C.	Same as No. 205, but 8000-ft. altitude scale in 50-ft. divisions, in velvet-lined morocco case....	EPISODE
No. 205D.	Same as No. 205, but 10,000-ft. altitude scale in 50-ft. divisions, in velvet-lined morocco case....	EPISTERM
No. 205E.	Same as No. 205, but 12,000-ft. altitude scale in 50-ft. divisions	EPITAPH
No. 205F.	Same as No. 205, but 16,000 ft. altitude scale in 100-ft. divisions	EPITHET
No. 206.	Leather Sling Case for Nos. 205-205F, in lieu of morocco..	Each
No. 206A.	Extra Leather Sling Case for Nos. 205-205F.....	
No. 206B.	Extra Morocco Case for Nos. 205-205F.....	
No. 206D.	Lietz Special Leather Case for Nos. 205-205F, as adopted by timber cruisers. If in lieu of the morocco.....	
	If extra	

POCKET THERMOMETERS

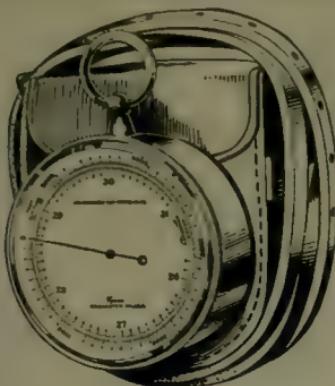


No. 207

No. 207.	Pocket Thermometer, 5-inch glass cylinder, porcelain scale, hard rubber or nickel screw case, mercury tube approximate scale range 20 to 130 degrees F.	Code Word, EPITOME
	For other Pocket Thermometers see page 152.	

See price list in back of catalog.

ALTITUDE BAROMETERS

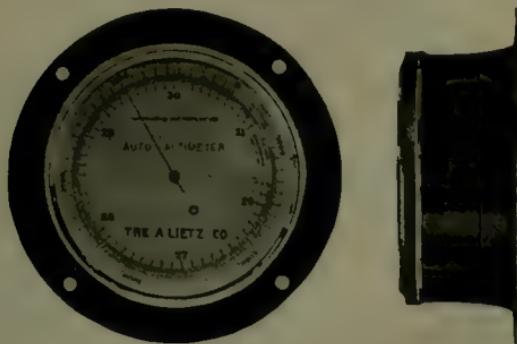


No. 205½D

These Barometers are "Direct Reading." The scales have been redesigned so that the altitude scale is in equal divisions, overcoming the difficulty met in the past in that the altitude scales were unequally divided, and as a consequence they had to be used with the zero of the scale at a fixed point and a sum worked out for correct readings, or the scales were made to revolve so the zero could be set at 0 feet. If used in the latter manner the readings were only approximate and grew in error the higher the altitude. With the "direct reading" scale all chances of error are eliminated.

No. 205½D. Altitude barometer 2½-inch silvered metal dial, aluminum case, altitude scale 10,000 ft. in 50-foot divisions, in velvet-lined leather sling case.....Code Word, **EQUATOR**

AUTO ALTITUDE BAROMETERS



No. 208D

No. 208D. Auto Altimeter, 2½-inch dial, with flange at back for screwing to dashboard. Altitude scale 10,000 ft. in 50-foot divisions.....Code Word, **EQUERRY**

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

SPECIAL SURVEYING ANEROID BAROMETERS



These instruments are specially designed for use of the engineer and geologist for ascertaining and checking slight differences in elevation. Made in two sizes, 3 and 5 inches in diameter, and in aluminum or stout bronze cases. Silvered metal dial with vernier on rack movement, reading lens arranged to traverse entire circle. Carefully selected movement, compensated for temperature, each instrument in leather sling case.

Nos. 208-211ALF

FACE 5-INCH DIAMETER

					Code Word
No. 208.	Bronze Case, Altitude Scale	3,000 feet.....			ERBIUM
No. 208B.	" " "	6,000 "			ERECTOR
No. 208D.	" " "	10,000 "			EREMITE
No. 208F.	" " "	16,000 "			ERGMETER
No. 208AL.	Aluminum Case "	3,000 "			ERGOT
No. 208ALB.	" " "	6,000 "			ERMIN
No. 208ALD.	" " "	10,000 "			EROTIC
No. 208ALF.	" " "	16,000 "			ERUDITE

FACE 3-INCH DIAMETER

					Code Word
No. 210.	Bronze Case, Scale 4,000 feet ascert, 2,000 feet descent				ESCALADE
No. 210A.	Aluminum Case, Scale 4,000 feet ascent, 2,000 feet descent				ESCARP
No. 211.	Bronze Case, Altitude Scale 3,000 feet.....				EXCELSIOR
No. 211B.	" " "	6,000 "			EXCHEQUER
No. 211D.	" " "	10,000 "			EXCLAVE
No. 211F.	" " "	16,000 "			EXCRETA
No. 211AL.	Aluminum Case "	3,000 "			EXCURSION
No. 211ALB.	" " "	6,000 "			EXEMPLAR
No. 211ALD.	" " "	10,000 "			EXOGEN
No. 211ALF.	" " "	16,000 "			EXPLORER

See price list in back of catalog.

BRASS CASE BAROMETERS

Nos. 220-225



We offer the highest grade of Compensated Barometers. Guaranteed dependable, each instrument being tested before delivery under our Standard Vacuum Air Pump, with the mercurial standard. Made with open-face dial and brass case, highly polished and lacquered.

- | | |
|-----------|---|
| No. 220. | 3 -inch face, each |
| No. 221. | 4 -inch face, each |
| No. 222. | 5 -inch face, each |
| No. 223. | 6½-inch face, each |
| No. 224. | 8 -inch face, each |
| No. 225. | 10 -inch face, each |
| No. 223G. | 6½-inch face, with graduations on glass, exposing full works,
brass case, each |

WALL FLANGE BAROMETERS (Brass Case)



Nos. 226-228

These Barometers are of the same high grade as our Nos. 220-225 line, but differ from them in that they are screwed to the wall through a flange.

- | | |
|----------|--|
| No. 226. | 5 -inch face, each |
| No. 227. | 6½-inch face, each |
| No. 228. | 8 -inch face, each |
| No. 230. | Direction Charts for reading Barometers. |

See price list in back of catalog.

BAROGRAPHHS, THERMOGRAPHHS, HYDROGRAPHHS, ETC.

Self-recording instruments are required where a continuous record is sought. They naturally assure of greater reliability of readings than when taken by the individual from instruments that have to be read at stated periods. Used mostly for engineering reconnaissance and by aero students.

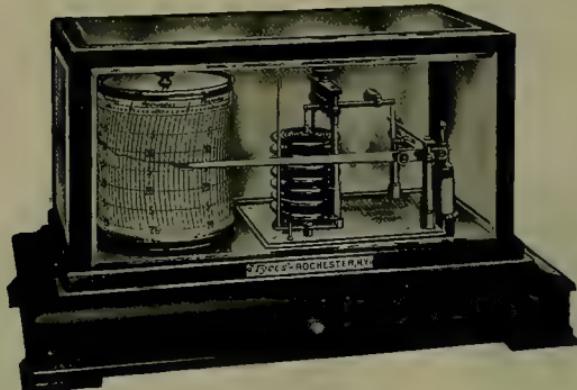
POCKET ALTITUDE BAROGRAPHHS

- No. 235. Pocket Barograph, size $4\frac{3}{4} \times 3\frac{3}{8} \times 1\frac{1}{8}$; weight about 1 lb. Metal, morocco covered case, with glass insert to read chart. Charts ruled to represent time in half hours for 24 hours and the pressure in feet of altitude. The pen makes contact every two minutes. This instrument also records atmospheric changes. We furnish with the instrument 50 graduated charts and one bottle of barograph ink.
- No. 235A. Reading to 4,000 feet altitude. Price complete.....
- No. 235B. Reading to 7,800 feet altitude. Price complete.....
- No. 235C. Reading to 15,000 feet altitude. Price complete.....

Extras for Pocket Barographs

- No. 236. Extra Charts per set of 50.....
- No. 237. Extra Bottle Barograph Ink.....
- No. 238. Extra Leather Carrying Case.....

RECORDING BAROMETERS (Barographs)



No. 240

- No. 240. Highest grade Recording Barometer, with front opening drawer with two divisions for holding used and unused charts. Weekly charts recording air pressure from 28 to 30.5 inches by 20ths of inch. Seven vacuum boxes, eight-day clock movement, jeweled. Complete with charts for one year and bottle of barograph ink..... Code Word, **FABEL**

For extra charts, ink and parts see bottom of page 146.

See price list in back of catalog.

RECORDING BAROMETERS (Barographs)



No. 242

No. 242. Recording Barometer, simplified form. The recording pen is operated by a large vacuum chamber concealed in the base of the instrument. High-grade clock movement, jeweled, running eight days. Weekly charts recording air pressure from 28 to 30.5 inches by 20ths of inch. Complete with charts for one year and a bottle of barograph ink.....
Code Word, **FABLING**

RECORDING THERMOMETER (Thermograph)



No. 244. Thermograph, gray enameled metal case, with handle and glass front, complete with year's supply of charts (No. 84-0-100 F.) ; (No. 85-20-120 F.) ; also bottle of recording ink.
Code Word, **FABLUS**

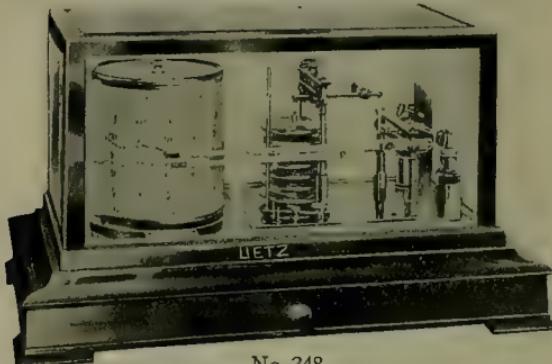
Charts showing a variety of ranges can be secured to suit particular requirements.
Write us if interested in other forms of recording thermometers or pyrometers.

The highest known average monthly temperature ever observed is that of 102 degrees F. for July at Death Valley, California. The lowest is —60 degrees F. for January at Werchomjansk, Siberia. "Weather and Weather Instruments." Stiffened cover 50c. Cloth cover \$1.00.

See price list in back of catalog.

RECORDING BAROMETER AND THERMOMETER

(Baro-Thermograph)



No. 248

No. 248. Baro-Thermograph. With this instrument it is possible to take both barometer and thermometer records on one chart. The range of the barometer is from 28 to 31 inches, while the thermometer shows a range of 0 to 120 degrees Fahrenheit in 2-degree lines. Two different colored inks are used, blue for the barometer and green for the thermometer, so that no confusion will arise in reading the two records. This instrument has eight vacuum boxes, all working parts exposed. Complete with charts for one year, pens and barograph inks, two colors.....Code Word, **FACULTY**

RECORDING HYGROMETER (Hygrograph)

No. 249. Hygrograph. This instrument records the moisture by single per cent from 1 to 100 per cent. The recording pen responds to the expansion and contraction of a quantity of fine hair affected by the variations of humidity. In weather-proof metal case, supplied with charts for one year, and one bottle of recording ink.....Code Word, **FADING**

Extra Charts for Recording Instruments (Set of Charts consists of one year's supply)

	Per set.
No. 2. Charts for Barograph Nos. 240 and 242, recording from 28 to 31 inches	
No. 6. Charts for Barograph Nos. 240 and 242, recording from 25 to 31 inches	
Charts for Barograph in the metric system to order.	
No. 84. Charts for Thermograph No. 244, recording from 0 to 100 degrees F.	
No. 85. Charts for Thermograph No. 244, recording from 20 to 120 degrees F.	
No. 20. Charts for Baro-Thermograph No. 248, recording 28 to 31 inches and 0 to 120 degrees F. in 2 degree lines.	
No. 249A. Charts for Hygrograph No. 249.....	

ACCESSORIES FOR RECORDING INSTRUMENTS

Each

No. 250A. Extra Pens, ordinary.....
No. 250B. Extra Pens, V pattern.....
No. 250C. Recording Ink, plain bottle.....
No. 250D. Recording Ink, stoppered bottle.....
No. 250E. Gimbal Hook for suspending barograph from ceiling on board ship..

See price list in back of catalog.

HYGROMETERS AND PSYCHROMETERS



No. 252

For determining the relative and absolute humidity and dewpoint and foretelling frosts in connection with tables and charts as furnished with the instrument



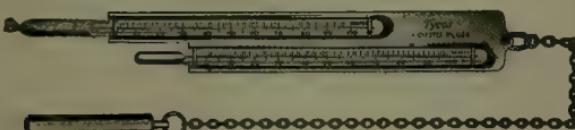
No. 256

Sling Psychrometer and
Protecting Case

No. 252. Mason's Hygrometer (wet and dry bulb), magnifying mercury tubes, black oxidized brass scales, white-filled figures and graduations, insulating brass supports, mahogany finish board, size $8\frac{1}{2} \times 4\frac{1}{2}$ inches. Approximate scale range 10 to 120 degrees. Complete with U. S. Government tables. Code Word, **FAGGIN**

ACCESSORIES FOR HYGROMETERS

- No. 252A. Extra Thermometer (wet or dry) for No. 252.....
- No. 252B. Extra Glass Bulbs for No. 252.....
- No. 252D. Extra Silk Wicks for No. 252.....
- No. 256.** Sling Psychrometer..... Code Word, **FAGLON**
With 12-inch engraved stem thermometers graduated 0 to 100 degrees Fahrenheit in $\frac{1}{4}$ degrees.



- No. 257.** Pocket Sling Psychrometer..... Code Word, **FAGUS**
Seven inches long with chain sling, 5-inch engraved stem thermometers graduated 0 to 100 degrees Fahrenheit in 1 degree, with leather carrying case.
- No. 256A.** Extra engraved Thermometer for No. 256.....
- No. 257A.** Extra engraved Thermometer for No. 257.....
With each instrument we supply copy of U. S. Weather Bureau tables and directions for determining humidity, etc.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

**STANDARD MAXIMUM AND MINIMUM
THERMOMETERS**
Self-registering

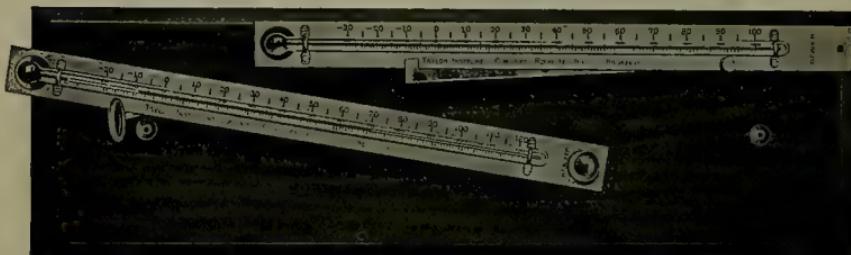


FIG. 1

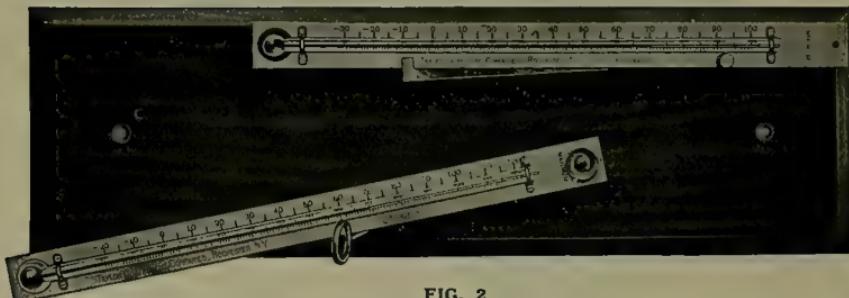


FIG. 2

When the maximum thermometer is set in position as in Fig. 1 the mercury passes over the contraction just above the bulb and falls into the bore of the tube. To take the maximum reading, the pin shown in Fig. 1 is carefully removed and placed in the lower hole, as indicated in Fig. 2, and the thermometer scale is carefully lowered until it rests again on the pin. The mercury will then rest against the contraction, and the top of the mercury column will indicate the maximum temperature since the thermometer was last set.

After the reading has been taken, the maximum tube and scale should be lowered to a perpendicular position and if this does not unite the column of mercury with that in the bulb, whirl the scale on the pivot to which its top end is attached. When the mercury in bulb and bore have united return the scale to the position in Fig. 1 and thermometer is set for the next reading.

No. 265. Maximum and Minimum Set (*best grade*) with certificates.....

Code Word, **FALCON**

Engraved plain-glass tubes, graduated in single degrees, with round bulbs; mounted on 12-inch aluminum scales, on which are marked the figures every 10 degrees and a line every five degrees; approximate temperature range 20° below zero to 120° F. above; minimum tube filled with uncolored spirit; brass insulating supports with binding screws; mahogany-finish board 17 inches by 5 inches.

No. 266. Maximum Registering Thermometer (*best grade*) with certificate..

Code Word, **FALCONER**

Plain-glass mercury-filled tube mounted on 12-inch aluminum scale, with insulating support, but without board; approximate temperature range 20° below zero to 120° F. above.

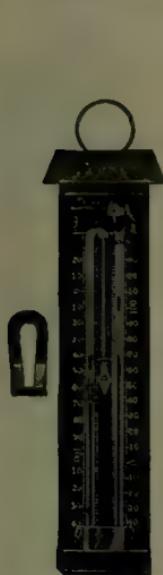
No. 267. Minimum Registering Thermometer (*best grade*) with certificate..

Code Word, **FALCONRY**

Plain glass tube filled with uncolored spirit, mounted on 12-inch aluminum scale, with insulating support, but without board; approximate temperature range 20° below zero to 120° F. above.

See price list in back of catalog.

SELF-REGISTERING THERMOMETERS



Nos. 278-279C



No. 280



Nos. 282-283 1/2

Each

- No. 278.** Standard Grade Six's Pattern Maximum and Minimum Self-Registering Thermometer, black oxidized brass scales, white-filled figures and graduations, black japanned tin case. Approximate scale range 10 to 40 degrees below zero to 120 degrees F. above, 8-inch
- No. 279.** Same as No. 278, but 10-inch
- No. 278C.** Same as No. 278, but mounted in copper case instead of japanned case, 8-inch
- No. 279C.** Same as No. 279, but mounted in copper case instead of japanned case, 10-inch
- No. 280.** Common Grade Self-Registering Thermometer, boxwood, black filled figures, polished on all sides. Scale range 10 to 40 degrees below zero to 120 degrees F. above, 10-inch
- No. 282.** Copper Case Thermometer, standard grade, magnifying mercury tube, oxidized brass scale, white-filled figures and graduations, brass screw clasps. Scale range 10 to 40 degrees below zero to 120 degrees F. above, 10-inch
- No. 283.** Same as No. 282, but 12-inch
- No. 282 1/2.** Copper Case Thermometer, similar to No. 282, but scale range 0 to 220 degrees F., 10-inch
- No. 283 1/2.** Copper Case Thermometer, similar to No. 282, but scale range 0 to 220 degrees F., 12-inch

See price list in back of catalog.

THERMOMETERS



No. 284-285



Nos. 288-289



No. 294

Each

- No. 284.** Cabinet Thermometer, standard grade, magnifying mercury tube, black metal scale with silver engravings, bronze screw clasp and guard, mounted on neat wooden back with rounded edges, finished in mahogany or Circassian walnut. Approximate scale range 20 to 120 degrees or 30 to 120 degrees F., 6-inch.
- No. 285.** Same as No. 284, but 8-inch.
- No. 288.** Cabinet Thermometer, standard grade, magnifying mercury tube, black oxidized brass bevel-edged scales, white-filled figures and graduations, bronze screw clasp and guard, finished in golden and weathered oak. Approximate scale range 30 degrees below zero to 120 degrees F. above, 8-inch.
- No. 289.** Same as No. 288, but 10-inch.
- No. 294.** Cabinet Thermometer, common grade, magnifying mercury tube, black oxidized brass scale, white-filled figures and graduations, nickelized straps and guard, wooden black, walnut or birch finish. Approximate scale range 20 degrees below zero to 120 degrees F. above, 8-inch.

See price list in back of catalog.

ENGRAVED STEM CHEMICAL THERMOMETERS

Ordinary Grade

Plain mercury tubes, $\frac{1}{4}$ -inch diameter, each in a turned wood box.

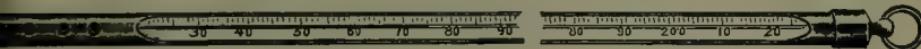


	Length	Scale	Approximate scale range	Sub-division	Each
No. 300A.....	12"	Fahrenheit,—	20° to 120°	2°	
No. 300B.....	12"	Fahrenheit,	0° to 220°	2°	
No. 300C.....	12"	Fahrenheit,	30° to 300°	2°	
No. 300D.....	14"	Fahrenheit,	30° to 400°	2°	
No. 300E.....	16"	Fahrenheit,	30° to 650°	2°	
No. 301A.....	12"	Centigrade,—	10° to 110°	1°	
No. 301B.....	12"	Centigrade,	0° to 150°	1°	
No. 301C.....	14"	Centigrade,	0° to 200°	1°	
No. 301D.....	16"	Centigrade,	0° to 350°	1°	

ARMORED ENGRAVED STEM THERMOMETERS

For 3-inch Immersion

For all purposes requiring the use of Engraved Stem Thermometers we recommend, wherever practical, the armored type. The lessened liability to breakage in use will be found to more than compensate for the added cost.



	Length	Scale	Scale Range	Sub-division	Each
No. 305A.....	12"	Fahrenheit,—	40° to 120°	1°	
No. 305B.....	12"	Fahrenheit,	0° to 220°	2°	
No. 305C.....	12"	Fahrenheit,+	30° to 300°	2°	
No. 305D.....	14"	Fahrenheit,+	30° to 400°	2°	
No. 305E.....	16"	Fahrenheit,+	30° to 600°	2°	
No. 305F.....	16"	Fahrenheit,+	30° to 750°	2°	
No. 305G.....	16"	Fahrenheit,+100°	to 950°	5°	
No. 306A.....	12"	Centigrade,—	10° to 100°	1°	
No. 306B.....	12"	Centigrade,	0° to 150°	1°	
No. 306C.....	14"	Centigrade,	0° to 200°	1°	
No. 306D.....	16"	Centigrade,	0° to 300°	1°	
No. 306E.....	16"	Centigrade,	0° to 400°	1°	
No. 306F.....	16"	Centigrade,+50°	to 510°	2°	

Extra Thermometers for Above

No. 0305A	0305B	0305C	0305D	0305E	0305F	0305G
	0306A	0306B	0306C	0306D	0306E	0306F

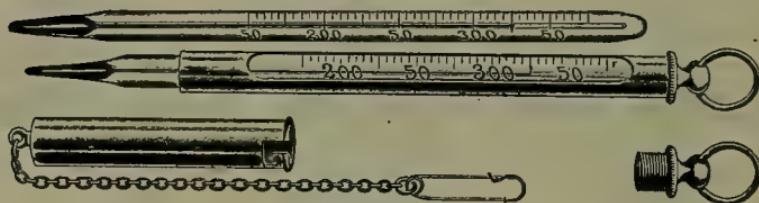
Each

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

**ARMORED ASPHALT-TESTING
THERMOMETERS**

Standard Grade



No. 312

Asphalt-Testing Thermometers, all glass, engraved stem, nickel-plated brass armor, made exceptionally robust to meet the requirements of use. Each

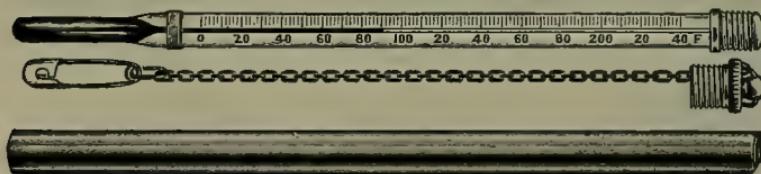
- No. 310.** Length 16 inches, temperature range 100 to 600 degrees, for use in testing asphalt.....
No. 311. Length 16 inches, temperature range 200 to 750 degrees, for use in testing sand,
No. 312. Length 6 inches, temperature range 200 to 400 degrees, for use of inspector

Extra Thermometers for Above

- No. 0310.** Extra Thermometer for No. 310.....
No. 0311. Extra Thermometer for No. 311.....
No. 0312. Extra Thermometer for No. 312.....

Each

POCKET THERMOMETERS



No. 315

- No. 315.** Pocket Thermometer, 5-inch, engraved stem, nickel-plated brass screw case and chain, magnifying mercury tube. Approximate scale range 30 degrees below zero to 120 degrees above, F.....
No. 316. Same as No. 315, but scale range 20 to 220 degrees F.....

Each

Extra Thermometers for Above

- No. 0315.** Extra Thermometer for No. 315.....
No. 0316. Extra Thermometer for No. 316.....

For other Pocket Thermometers see page 140.

See price list in back of catalog.

RAIN GAUGES



No. 320



Measuring Stick
Labeled
Extreme
Dome



Nos. 325-326

No. 320. U. S. Weather Bureau Standard Rain Gauge, as made by us, consists of a funnel, a receiver, overflow and a measuring stick. Gauge 25 inches high, funnel 8 inches in diameter.....Code Word, **FANION**

No. 321. Same as No. 320, but 13 inches high, funnel 3 inches in diameter....Code Word, **FANTAIL**

The rain collected by the funnel flows into the receiver, which is of smaller diameter than the funnel and so adjusted that the readings are magnified 10 times. To take reading insert measuring stick through the funnel into the receiver and note how high it is moistened. The sticks are graduated in 10ths and 100ths of an inch, one inch of rain actually being 10 inches on the stick.

To measure snow, remove the funnel and receiver and after collecting let it melt. Then pour into receiver and measure same as rain. Also measure full depth of snow.

Extra Measuring Sticks for the Above

No. 320A. Extra Measuring Stick for No. 320 Rain Gauge.....

No. 321A. Extra Measuring Stick for No. 321 Rain Gauge.....

SELF-REGISTERING RAIN GAUGE

No. 325. Self-Registering Rain Gauge, japanned metal case, porcelain dial reading to 10 inches in 1/100ths inches, heavy brass-edged receiver 8x8 inches.....Code Word, **FARLING**

No. 326. Same as No. 325, but polished copper case....Code Word, **FARMER**

The Self-Registering Rain Gauge has a receiver 8x8 inches. The rain enters this receiver and is collected in a bucket. When this bucket has received 1/100th of an inch of rain it tilts over, and the hand registers the fall as 1/100th of an inch. The tilting of one bucket brings another in position, which when filled overbalances, registers and brings the first bucket in position again. One complete revolution of the large hand indicates one inch of rain in 1/100ths, and the smaller dial registers up to 10 inches.

Mountains of Cloudland and Rainfall Paper, 5x8.....

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

JEWELLED ANEMOMETERS

Anemometers are used to measure the velocity of air currents and are of various designs. Used in tunnels, mines, sewers, also in hospitals, etc., and some patterns to measure the velocity of the wind are fixed on the roofs of buildings, schools, colleges or the private home. Each instrument tested and chart of corrections supplied.

Two-dial instruments will stand pressure of 1000 feet per minute.

Four-dial instruments will stand pressure of 3000 feet per minute.

Not guaranteed in temperatures exceeding 300 degrees F.

Anemometers supplied with patented zero-setting device.



No. 332A



No. 334A

Each

No. 332. Jeweled Airmeter, 4 dials reading to 100,000 feet, with zero-setting attachment, vane opening $2\frac{1}{2}$ inches.....

No. 332A. Same as No. 332, 6 dials reading to 10,000,000 feet, with zero-setting attachment, vane opening $2\frac{1}{2}$ inches.....

No. 334. Biram Anemometer, 3-inch diameter, two dials reading to 1,000 feet with disconnector and zero-setting attachment, in leather case

No. 334A. Same as No. 334, but 4-inch diameter and four dials reading to 100,000 feet, in leather case.....

No. 334B. High-Speed Anemometer, registering to 200,000 feet, with disconnector and zero-setting attachment, in leather case..

This instrument is capable of registering strong blast currents to 10,000 feet per minute.

Extra Leather Cases for Above

No. 335. Extra Leather Case for No. 334.....

No. 335A. Extra Leather Case for No. 334A or No. 334B.....

WATCH PATTERN ANEMOMETER

No. 338. Watch Pattern Anemometer, 2-inch diameter, two dials registering to 1,000 feet, with disconnector, hunting case, jeweled movement

See price list in back of catalog.

LIETZ HYDRAULIC INSTRUMENTS

Current Meters

The Lietz Electric Current Meters are the result of many years' experience in the construction of such instruments. Constant study and observation of these instruments under most severe conditions has made possible the development of the superior instrument, which we are offering today. We call particular attention to the ball point axis which we employ in place of the pivot axis, as used in other meters of this type. A longer maintenance of rating is made possible by the additional strength and stability of this bearing, being less liable to derangement from knocks they sometimes receive while in use. With this ball bearing, it is not necessary to lift the bucket wheels off the pivot when transporting the meter from place to place, while this, if neglected, often results in serious injury to pivots of meters of the other type.

The Lietz improved penta head has two binding posts, one indicating each revolution and the other every fifth revolution of the bucket wheels. These binding posts are both permanently attached, eliminating the chances of losing these small attachments, and the desired result is obtained by merely attaching the wire to either post. Lietz Current Meters are tested and rated at the foremost rating stations in the country and invariably the result obtained in rating these meters is evidence to the quality and accuracy of the instrument. Lietz Current Meters have been recognized today as the standard by many of our great reclamation and irrigation projects, as well as various branches of our Government and a number of foreign countries.

Water Registers

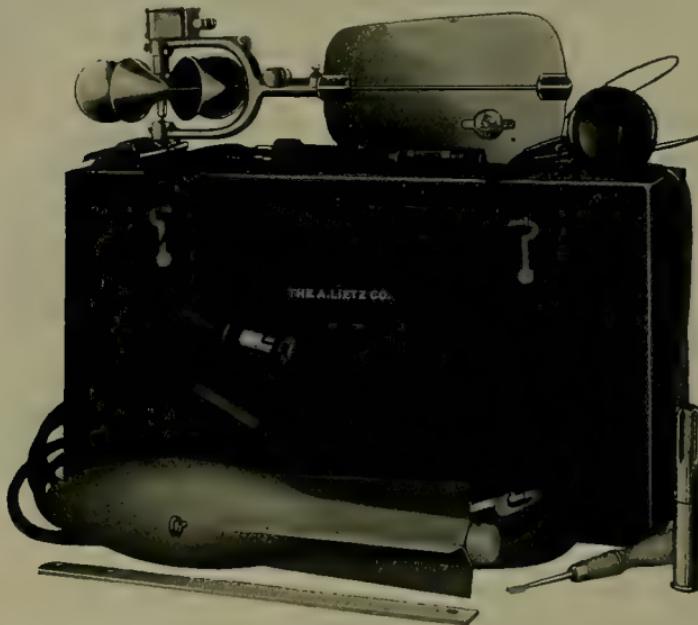
The Lietz Water Register, for automatically recording the rise and fall of water in reservoirs, lakes, canals, weirs, etc., was originally designed and manufactured by us for the U. S. Department of Agriculture over twenty years ago, and has found wide application. Its simplicity of construction, together with efficiency and moderate price, has created its popularity. We have made improvements from time to time, which have increased its efficiency, and the Register as made by us today constitutes the best moderate-price device on the market.

The customary ratios which we supply and aim to keep in stock are 1:1, 1:2, 1:5 and 1:10, also a device whereby the pencil movement can be changed and made to travel over the drum in a period of either 1 or 8 days. (See Lietz Duplex Time Water Register.) Any other ratio, as well as interchangeable ratios, can also be supplied.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

LIETZ ELECTRIC CURRENT METERS

For the measurement of water velocity in rivers and streams.



No. 345. Electric Current Meter indicating each revolution of the bucket wheel, including telephone sounder with dry battery, vest pocket size, twenty feet of cable and ten-pound torpedo-shaped lead weight. All conveniently packed in mahogany carrying case with lock and hooks, including all the essential accessories.

.....Code Word, **FIREBALL**

Individual Calibrated Rating Table,Code Word, **FIRKIN**

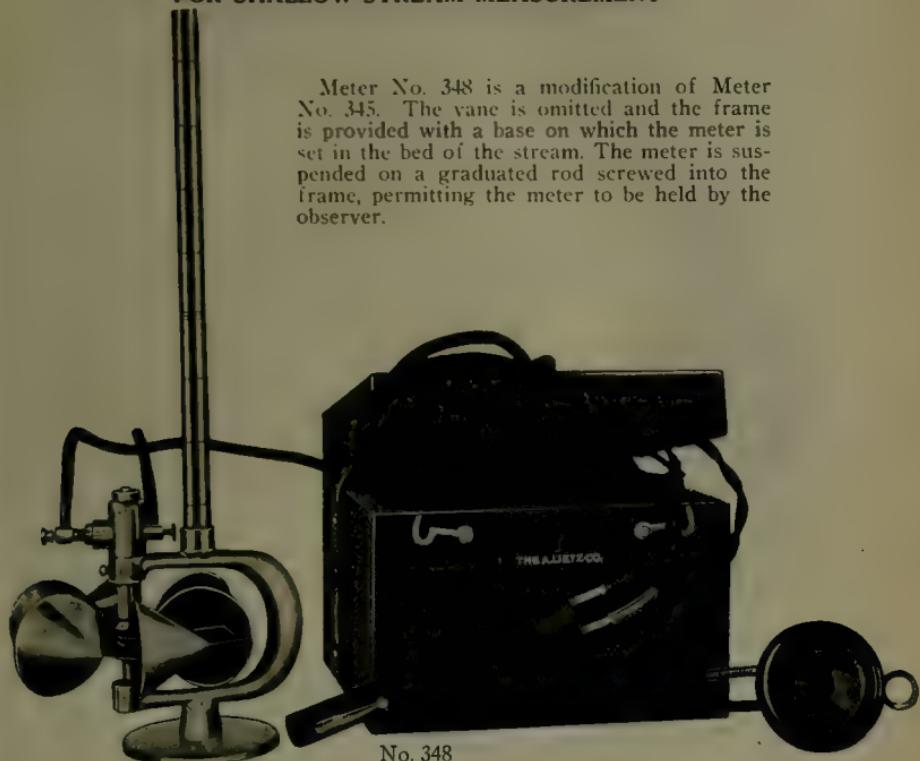
No. 347. Electric Current Meter with penta head, one binding post indicating each revolution and the other each fifth revolution of the bucket whcel. Including telephone sounder with dry battery, vest pocket size, 20 feet of cable and 10-pound torpedo-shaped lead weight. All conveniently packed in wooden box carrying case with lock and hooks. Including all essential accessories..Code Word, **FISHMAW**

Individual Calibrated Rating Table.....Code Word, **FIRKIN**

See price list in back of catalog.

**LIETZ ELECTRIC CURRENT METERS
FOR SHALLOW-STREAM MEASUREMENT**

Meter No. 348 is a modification of Meter No. 345. The vane is omitted and the frame is provided with a base on which the meter is set in the bed of the stream. The meter is suspended on a graduated rod screwed into the frame, permitting the meter to be held by the observer.



No. 348

No. 348. Electric Current Meter indicating each revolution of the bucket wheel. Including telephone sounder with dry battery, 20 feet of cable and rods. All conveniently packed in mahogany carrying case and canvas bag for rods, including all the essential accessories.....Code Word, **FISSURE**
Individual Calibrated Rating Table for both cable and rod suspension.....Code Word, **FIRKIN**

EXTRAS FOR CURRENT METERS

No. 346A.	Extra Cable, per foot.....
No. 346B.	Extra Lead Weight, 10 pounds.....
No. 346C.	Extra Lead Weight, 15 pounds.....
No. 346D.	Extra Graduated Tube, 8 feet long, four 2-ft. sections, in canvas case Code Word, FIRSTLING
No. 346E.	Socket Cable Connection.....
No. 346F.	Current Meter Screws.....
No. 346G.	Binding Post Screws.....
No. 346H.	Pivot Points
No. 346I.	Contact Plugs for cable.....
No. 346J.	Receiver and Holder.....
No. 346K.	Battery complete with holder.....
No. 346KK.	Battery only to fit holder.....
No. 346M.	Screw Driver.....
No. 346N.	Oil Can

See price list in back of catalog.

STREAM FLOW RECORD SHEETS

- No. 349. Sheets $8\frac{1}{2} \times 11$ inches, punched for three-ring binder with various columns and headings for recording stream-measurement record. Price per 100 sheets.....
- No. 349A. Three-Ring Binder, canvas covered, $8\frac{1}{2} \times 11$ inches, for stream-flow record sheets. Each.....



No. 350

*The split-second Stop Watch enables one to take two separate records at one time.

STOP WATCHES

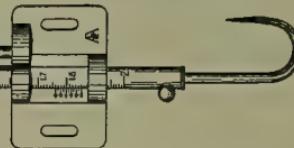
- No. 350. Stop Watch, *split-second, nickel-plated case, lever movement, 30-minute register by one-fifth seconds.....Code Word, **FIXITY**
- No. 351. Stop Watch, single sweep, nickel case, cylinder movement, 30-minute register by one-fifth seconds.....Code Word, **FLAGMAN**
- No. 351A. Decimal Timer..Code Word, **FLAMBAGE**
- No. 353. Stop Watch Chronograph, single sweep movement, plain-polished or nickel case, 60-minute register by one-fifth seconds.....Code Word, **FLAMINGO**

Made after suggestions of Messrs. Metcalf & Eddy, Consulting Engineers of Boston, Mass.

IMPROVED HOOK GAUGE

Entirely of Metal—Nickel-Plated

Illustration of the Improved Hook Gauge No. 355. It consists of a long, thin metal tube with a hook at one end and a metal plate with holes for attaching it to a flume at the other. A vernier scale is attached to the tube near the hook. The tube is graduated in feet and inches.



No. 355

- No. 355 (Old No. 372). Improved Hook Gauge, made entirely of metal, nickel-plated. Tube two feet long, graduated to feet, 10th and 100ths with vernier reading to 1000ths. The hook may be extended 12 inches from within the tube, permitting it to be set to the exact level of the water. Metal plate with holes for attaching gauge to side of flume.....Code Word, **FLIRTON**

Improved Metal Hook Gauges like No. 355, but with longer tubes, can be made on special order. Prices on application.

See price list in back of catalog.

LIETZ WATER REGISTERS

Their Operation and Installation

OPERATION

The Lietz Water Register is of simple construction with few parts, and its design assures easy operation. The clock has only one operation to perform, the releasing of the chain, to which the pencil carriage is attached, which travels across the graphic sheet. On one end of this chain is a counterweight, as will be noted in the illustration, which gives the necessary tension when the clock releases the chain. The clock movements used in Lietz Registers have been properly selected and have jeweled bearings, which is necessary to insure a uniformity of rate. The drum is controlled by the float which rests on the surface of the water. This type of construction is a great advantage over the old style, wherein the drum is revolved by the clockwork, inasmuch as it releases the clockwork from the extra labor of turning the drum so as to assure greater accuracy of time, and also in case of an extraordinary rise or fall of the water (greater than the capacity of the record sheet), the Lietz Water Register will simply make two or more revolutions, and the records can be easily read, while on the old type of construction, any rise or fall over the capacity of the register would be lost. The type of record obtained is termed either the hydrograph or the curve, which records the stage and time and is continuous over seven days, and presents graphically all of the fluctuations of stage and their time relations. This gives a picture record of conditions as seen at a glance by the curve on the chart.

INSTALLATION

After the Register has been secured in its proper place, and the outer galvanized cover taken off, remove the cap on the top of the clock case, through which access is had to the escapement wheel to start the clock movement. To start the clock movement, it is necessary to remove the strip of paper which has been put through the escapement wheel in order to prevent motion and wear during transportation. The pencil carriage is secured to the chain by a small plate and thumbscrew and may be adjusted to its proper place on the drum according to the days marked thereon. One end of this chain is wound around a cylinder on the outside of the clock case, which is manipulated by moving the ratchet wheel with the finger to its original position after the end of the week. Care should be taken that the chain is reeled on evenly, one layer only, to assure a uniform time record. On the other end of the chain a weight is attached, as shown in the accompanying illustration, to give it the proper tension. The float is suspended by a fine brass wire, a spool of which is supplied with the instrument, and the counterpoise is attached to the other end of the wire. Care must be taken to keep the guide rods for the pencil holder clean, so as to afford a free movement.

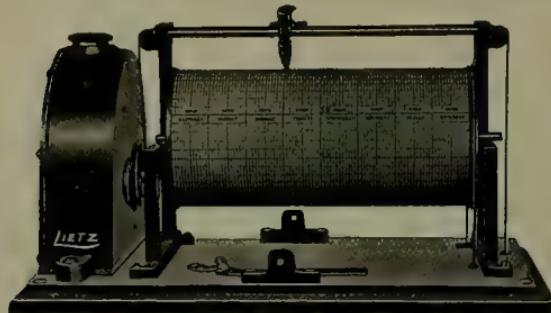
Details of installation depend largely upon local conditions. It is generally necessary to provide a box or tube for the float, smooth internally, and of sufficient size to allow a free movement of the float. Independent tubes may be used for the counterpoises, if not otherwise enclosed.

For the successful operation of mechanical devices, it is necessary that the patrolman or care-taker familiarize himself with their peculiarities.

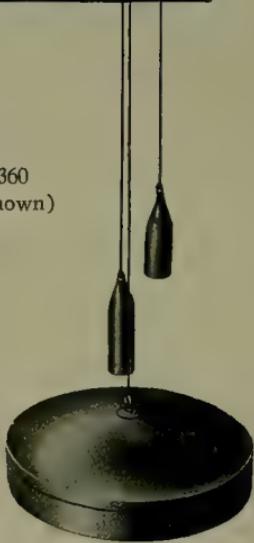
THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

LIETZ WATER REGISTERS

As made by us for the U. S. Department of Agriculture



Lietz Water Register No. 360
(Galvanized Iron Cover not shown)



- No. 360.** Lietz Improved Water Register with 12-inch drum, high-grade 8-day clock movement, complete with float, weights and strong, galvanized iron hood, 6 months' supply of Record Sheets, and directions for installation, gear 1:1.....Code Word, **FLANKER**
- No. 360A.** Same as No. 360, but geared for both 1:1 and 1:2 **FLASHING**
- No. 360B.** Same as No. 360, but geared for both 1:1 and 1:5 **FLEXOR**
- No. 360C.** Same as No. 360, but geared for both 1:1 and 1:10 **FLINCH**

See price list in back of catalog.

LIETZ DUPLEX TIME WATER REGISTERS

The Lietz Duplex Time Water Registers are a modification of our No. 360 Water Registers. By means of attaching an extra gear and reel to the clockworks, the pencil can be made to travel across the drum in a period of either one or eight days. Either result may be obtained as conditions necessitate, by winding the chain, which releases the pencil, on the proper reel.

No. 362. Lietz Duplex Time Water Register, with 12-inch drum, high-grade 8-day clock movement, complete with float, weights and strong galvanized iron hood, 6 months' supply of record sheets, and directions for installation. Geared 1:1.....
.....Code Word, **FLINDER**

No. 362A. Same as No. 362, but geared for both 1:1 and 1:2.....Code Word, **FLIPPER**

No. 362B. Same as No. 362, but geared for both 1:1 and 1:5.....Code Word, **FLOCKER**

No. 362C. Same as No. 362, but geared for both 1:1 and 1:10.....Code Word, **FLOORER**

Lietz Duplex Time Water Registers can also be geared to any other desired ratio on special orders. Prices on application.



No. 362

Illustration showing two reels for chain as incorporated in our Duplex Time Water Registers.

Extras for Lietz Water Registers

- No. 365A.** Extra Register Sheets for 12-inch drum for weekly record. (When ordering state how register is geared.) Per 100..
- No. 365C.** Extra Register Sheets for 12-inch drum, for daily record.* (When ordering state how register is geared.) Per 100..
- No. 365E.** Extra Float for water register.....
- No. 365F.** Extra Cap for clock case.....
- No. 365G.** Extra Weights
- No. 365H.** Extra Screws to clamp galvanized cover to base.....
- No. 365J.** No. 34 B. & S. Gauge Brass Wire for float and weight. Per spool
- No. 365K.** Gold-Filled Chain for pencil carriage.....

*Daily record sheets can only be used with our Duplex Time Registers.

See price list in back of catalog.

RECORDING TIDE GAUGE



No. 367. The Lietz Self-Recording Tide Gauge. The records are obtained on a continuous roll of blank white paper, 13 inches wide and 22 yards long, through the graphic illustration of the pencil "D", which is actuated by the tides by means of the float "A", while the clock "H" revolves the cylinder "E", causing the supply roll of paper to travel over it and onto the record roller "G", which in turn is wound tightly through the fall of its counterweight. The paper is guided over the cylinder by means of small projecting pins or burs attached to its ends peripherally, which cause a perforation of the paper at intervals of one inch, equal to two hours of record. The scale on which the curve is drawn is such that one inch on the paper equals one foot in tidal height.

The Reference Pencil "I", which may be shifted along its carriage, is a convenience in the establishment of either a mean or initial reading, which readily aids in the taking of observations.

The gauge, once installed in working order, need not be visited more than once in seven days for the purpose of winding the driving clock and the counterweight attached to the record roller.

Price, complete with all accessories, including a galvanized iron hood (not shown in the illustration) and 6 rolls of record paper. Code Word, **FLORAN**

No. 368. Extra Record Paper for Tide Gauge. Per roll of 22 yards Code Word, **FLORATO**

See price list in back of catalog.

HENSOLDT IMPROVED PRISM BINOCULARS



Mountain-Dialyt 10x

Showing Removable Prism System for this and all Dialyt Models

Aluminum Frames, covered in black morocco leather. Jointed cross bars for adjustment of pupillary distances. Universal focusing arrangement, and one turning eye-piece, graduated plus and minus for unequal strength of eyes. Binoculars contained in genuine leather case with sling strap.

The novel combined prism of the Hensoldt Binocular as shown in the above illustration allows the employment of object glasses of larger aperture (up to 2 inches), thereby giving a higher degree of brightness than other glasses. It also permits the reduction of the Aluminum Frame to the slender shape of a telescope, as well as securing the optical elements more rigidly in proper relation to each other.



This illustration shows the easy access to internal optical parts for cleaning.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

HENSOLDT IMPROVED PRISM BINOCULARS



Theater-Dialyt



Jagd-Dialyt

Prices and Specifications (Genuine Leather Sling Case)

Model	Magnification.	Diam. of Objective	Each
No. 375. Theater-Dialyt 3½×	3½ times	16 Millimeters...	
Universal-Dialyt 6×	6 times	26 Millimeters...	
Jagd-Dialyt 6×	6 times	36 Millimeters...	
Marine-Dialyt 8×	8 times	50 Millimeters...	
Mountain-Dialyt 10×	10 times	50 Millimeters...	
Mountain-Dialyt 16×	16 times	50 Millimeters...	
Mountain-Dialyt 18×	18 times	50 Millimeters...	

No. 376. Hensoldt Monoculars (for one eye only) half price of Binoculars.
Note: 25 millimeters are equal to one inch.



Field of view
As seen with a Galilean Glass
6 X Magnification



As seen with Hensoldt 6 X Magnification

Hensoldt Prismatic Binoculars possess perfect definition, flatness of field and equal illumination up to the edge of the image.

See price list in back of catalog.

HENSOLDT PRISM BINOCULARS

Stereo Model



No. 380

The Stereo Model Hensoldt Prism Binoculars are manufactured with the regular prism system. They are made with as strong an objective as is possible with this type of prism, so as not to diminish the illumination. By applying improved oculars the field of vision is greatly enlarged and a sharp, clear definition is permitted to the very edge. Joint and main body are of the greatest stability and are made of one piece, just as the "Dialyt" series. The focusing arrangement works independently of the body and joint. For those whose needs demand this style of Binocular, the Stereo Model Hensoldt Prism Binocular is the most convenient, in weight and size, of its type.

No. 380. STEREO MODEL HENSOLDT PRISM BINOCULARS

Prices and Specifications (with genuine Leather Sling Case)

Model	Magnification	Diameter of Objective Lens	Each
Telsex 6×	6 times	24 Millimeters..	
Telacht 8×	8 times	24 Millimeters..	
Teljagd	6 times	30 Millimeters..	
Telachtar	8 times	30 Millimeters..	
Telzwoelf	12 times	30 Millimeters..	



No. 385

TRIPOD AND CLAMP FOR FIELD GLASSES

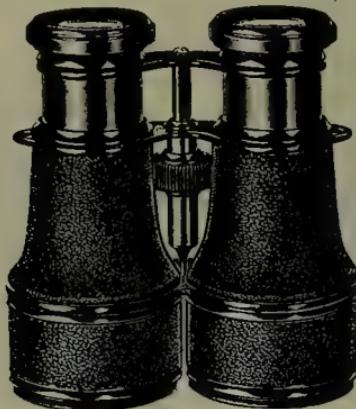
No. 385. Adjustable clamp suitable for mounting on Metal Extension Tripod, suitable for any Field Glass or Prismatic Binocular.
Each

On special order these Binoculars can be furnished in tan leather.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

FIELD GLASSES



Nos. 392-394

Lietz Superior Quality Field Glasses, black leather covered, fine japanned finish, in leather case with strap.

- | | | |
|----------|--|------|
| No. 390. | Lietz Field Glass, 6 lenses, 2-inch objectives, short body, in leather case with strap; magnification, $2\frac{3}{4}$ times; field at 1000 yards, 200 yards | Each |
| No. 392. | Lietz Field Glass, 6 lenses, 2-inch objectives, long body with sunshades, in leather case with strap; magnification, $3\frac{1}{2}$ times; field at 1000 yards, 120 yards..... | |
| No. 393. | Same as No. 392, but $2\frac{3}{4}$ -inch objectives, in leather case, with strap; magnification, 5 times; field at 1000 yards, 80 yards.... | |
| No. 394. | Same as No. 392, but $2\frac{1}{2}$ -inch objectives, in leather case with strap; magnification, $3\frac{3}{4}$ times; field at 1000 yards, 110 yards. | |

In addition to the above glasses we carry a complete line of Marine Glasses and Telescopes, etc. If interested send for our Nautical Catalog.

LIETZ LEVELING RODS

The Leveling Rods, Nos. 410-425, are of our own manufacture, graduated to hundredths, by uniform, clean divisions. The black numerals, corresponding to the tenths, have an exact height of 0.06 foot and the red or foot numerals are 0.08 foot high. This affords a rod reading at distances where graduation lines disappear. The wood is the best, thoroughly seasoned. The target and all connecting metal parts are cast in one piece; the vernier reads to thousandths; the scale is brass, face of target japanned. We recommend these rods to be the best in the market. Made in two self-reading designs, known as the block and line graduations, similar to the Philadelphia pattern.

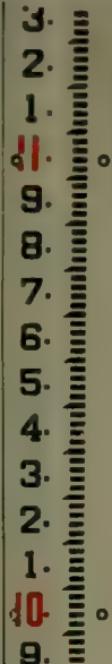
We also manufacture a complete line of Flexible Leveling Rods and Stadia Rods as listed on the following pages.

See price list in back of catalog.

FLEXIBLE LEVEL RODS



No. 400



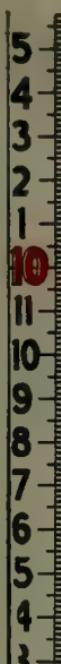
No. 401



No. 402



No. 406



No. 408

The Lietz Flexible Rods are 12 feet long and 3 inches wide.

Code Word

- No. 400. Lietz Flexible Level Rod, diamond design, alternating, painted on especially prepared oil canvas. May be rolled up in a package 3 inches long and less than 1½ inches in diameter. Weight 8 ounces. Punched with eyelets for attachment to board.....**FLORIST**
- No. 401. Lietz Flexible Level Rod, same as No. 400 but Philadelphia design**FLORY**
- No. 402. Lietz Flexible Level Rod, same as No. 400 but in the metric system.....**FLOSSH**
- No. 406. Chicago Flexible Level Rod, 1½ inches wide, 12½ feet long, graduated to 100ths of feet.....**FLOUNDER**
- No. 406A. Same as No. 406 but 16½ feet long.....**FLOURY**
- No. 406B. Same as No. 406 but 20½ feet long.....**FLOWBIT**
- No. 408. Chicago Flexible Level Rod, 1½ inches wide, 12½ feet long, graduated in feet, inches and eighths.**FLOWERET**

See price list in back of catalog.



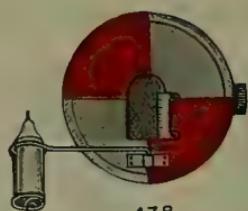
THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS



410-415



421-425



438



430-431



446



447

LEVELING RODS

Complete With Targets

Nos. 410-415—LINE GRADUATION

No.	410	411	412	413	414	415
Length in feet.....	8 to 15	7 to 13	6½ to 12	5 to 9	4 to 7	3 to 5
Code Word	FLUFF	FLUID	FLUKE	FLUNK	FLUSH	FLURRY

Nos. 421-425—BLOCK GRADUATION

No.	421	422	423	425
Length in feet.....	7 to 13	6½ to 12	5 to 9	3 to 5
Code Word	FLUTIST	FLUWAL	FLUX	FLUXION

No. 428. Metric Leveling Rod, 2.2 meters, extending to 4 meters.....
Code Word, **FLYBLOW**

ARCHITECTS' RODS

- No. 430.** Architects' Leveling Rod, 5½ to 10 feet, brass mounted, with clamp and target, divided in feet, inches and 8ths, vernier reading to 64ths of inch.....
Code Word, **FLYKITE**
- No. 431.** Same as No. 430, but divided in feet, 10ths and 100ths, vernier reading to 1000ths of foot.....
Code Word, **FLYWHEEL**

Extra Targets and Canvas Bags for Leveling Rods

- No. 437.** Extra Target for Philadelphia leveling rod.....
- No. 438.** Target with swinging candle bracket for illuminating vernier, for use in mines, tunnels, etc.....
If ordered with a new rod in lieu of the ordinary, extra.....
- No. 439.** Extra Target for architects' rods, Nos. 430-431.....
- No. 440.** Extra Target or Clamp Screw for leveling rods.....
Code Word
- No. 441.** Sewed Canvas Bag for Philadelphia leveling rods to 12 feet **FOAM**
- No. 442.** Sewed Canvas Bag for Philadelphia leveling rods to 15 feet **FOCAL**

LIETZ CROSS SECTION RODS

- No. 446.** Lietz Cross Section Rod, one-piece, 10 feet long; graduated in feet and 10ths, with level vial at each end.....
Code Word, **FOEMAN**

- No. 447.** Lietz Vertical Cross Section Rod, hardwood, 7 feet long, 1 inch square with iron shoes. Graduated on four sides in feet and 10ths reading both ways, for use in conjunction with horizontal cross section rod No. 446.....
Code Word, **FOGBANK**

ROD LEVEL

- No. 449.** Lietz Improved Rod Level.....
Code Word, **FOGBELL**

This Rod Level is an improved type, used to hold rod or pole of any shape perpendicular. The level bubbles are sunk in the casting at right angles to each other, thereby lessening the possibility of breakage, as well as making it easier for the rodman to hold the bubbles in the center than the old form of circular spirit levels. The latter are continually leaking and it is impossible to keep them in order.

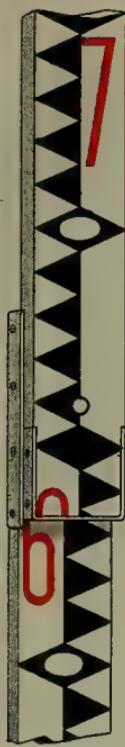
The Improved Rod Level can either be fastened to the rod by means of a flat-head screw, for which there is a key slot provided, or pressed against the rod or pole while holding. Indispensable for stadia work.

No. 449

See price list in back of catalog.



THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS



450-455
DIAMOND DESIGN



450-455
FOLDED



460-462



465



466



468



469

LIETZ STADIA RODS

For designs of Flexible Level Rods, see page 167.

	Code Word	
No. 450.	Lietz Stadia Rod, $2\frac{3}{4}$ in. wide, diamond design (alternating), 12 feet long, 2-fold. Same design as Flexible Rod No. 400.....	FOILER
No. 451.	Lietz Stadia Rod, $2\frac{3}{4}$ in. wide, diamond design (alternating), 15 feet long, 3-fold. Same design as Flexible Rod No. 400.....	FOISTER
No. 454.	Lietz Stadia Rod, $2\frac{3}{4}$ in. wide, graduated in the metric system, 3 meters long, 2-fold. Same design as Flexible Rod No. 402.....	FOLDEROL
No. 455.	Lietz Stadia Rod, $2\frac{3}{4}$ in. wide, graduated in the metric system, $4\frac{1}{2}$ meters long, 3-fold. Same design as Flexible Rod No. 402.....	FOLIOLE
No. 460.	Lietz Plain Stadia Rod, Philadelphia block design, in one piece with tapering rib, 10 feet long.	FOLLICLE
No. 461.	Same as No. 460, but 12 feet long.....	FOLLOWER
No. 462.	Same as No. 460, but 14 feet long.....	FOLLY

RANGING POLES

Steel Ranging Poles, $\frac{1}{2}$ -inch in diameter, octagonal, solid with pointed end, divided in feet, alternately red and white.

	Code Word	
No. 465A.	6 feet	FOMER
No. 465B.	8 feet	FONDU
No. 465C.	10 feet	FONTAL

Wooden Ranging Poles, $\frac{7}{8}$ to $1\frac{3}{8}$ inches in diameter, tapered, octagonal with steel-pointed shoe, divided in feet, alternately red and white.

	Code Word	
No. 466A.	6 feet	FOOTBALL
No. 466B.	8 feet	FOOTMAN
No. 466C.	10 feet	FOOTPAD

Wooden Ranging Poles, like No. 466, but divided in meters.

	Code Word	
No. 467A.	2 meters	FORAGE
No. 467B.	2 $\frac{1}{2}$ meters	FORAMEN
No. 467C.	3 meters	FORAY
No. 468.	Sectional Ranging Poles, 1 $1\frac{1}{16}$ -in. in diameter, round, steel. In two sections, each $4\frac{1}{2}$ feet long, jointed with metal telescope tubing, making an absolutely rigid pole $8\frac{1}{2}$ feet long with steel-pointed shoe. In two-pocket canvas bag ..	FOREBOW
No. 469.	Sectional Mining Pole, as No. 468, but $5\frac{1}{2}$ -in. in diameter and in three sections, each 33 in. long, lengthening out to $7\frac{1}{4}$ feet. In three-pocket canvas bag.....	FORECAST

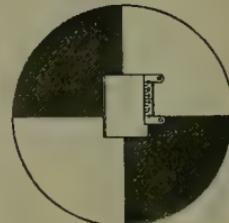
See price list in back of catalog.

CHICAGO JOINTED LEVELING AND STADIA RODS

CHICAGO JOINTED LEVELING RODS



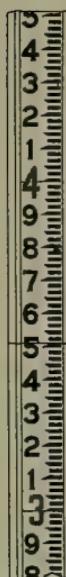
These Rods are made of 3 or 4 pieces of selected hardwood, 2 inches wide, 1 inch thick and $4\frac{1}{2}$ feet long. They are joined by telescope socket joints, making when put together a very rigid rod $12\frac{1}{2}$ or $16\frac{1}{2}$ feet long. The face is on one plane and the entire rod from top to bottom when extended is the same size, making it possible to use two targets for stadia work. The graduations are similar to our Philadelphia leveling rods Nos. 421-425 (BLOCK GRADUATION). The feet are marked in red figures and the 10ths in black figures. Each rod contained in a canvas carrying bag.



No. 472-2S

No. 470A. Chicago Jointed Leveling Rod, in 3 sections, each $4\frac{1}{2}$ feet long, making a rigid rod $12\frac{1}{2}$ feet long. Without target, in canvas carrying bag.....Code Word, **FORELAND**

No. 470B. Chicago Jointed Leveling Rod, in 4 sections, each $4\frac{1}{2}$ feet long, making a rigid rod $16\frac{1}{2}$ feet long. Without target, in canvas carrying bag.....Code Word, **FORELOCK**



CHICAGO JOINTED STADIA RODS

The Chicago Jointed Leveling Rod can be used for stadia work, but the Chicago Jointed Stadia Rod is designed for that purpose only. It is similar to the leveling rod, excepting that it is numbered from the top downward. By setting the upper stadia hair at "O", near the top of the rod, it saves calculation in estimating the distance. By the use of a pair of targets, readings to 1/1000 of a foot can be made a half mile away. An equivalent to 1/10 foot horizontally.

No. 471A. Chicago Jointed Stadia Rod, in 3 sections, each $4\frac{1}{2}$ feet long, making a rigid rod $12\frac{1}{2}$ feet long, without target, in canvas carrying bag.....Code Word, **FORERUN**

No. 471B. Chicago Jointed Stadia Rod, in 4 sections, each $4\frac{1}{2}$ feet long, making a rigid rod $16\frac{1}{2}$ feet long, without target, in canvas carrying bag.....Code Word, **FORESAIL**

TARGETS FOR CHICAGO JOINTED RODS



No. 472A. Fiber Target, round, with vernier for Chicago jointed leveling rods Nos. 470A and 470B, each.....Code Word, **FORESTAY**

No. 472B. Fiber Target, oval, constructed with open back so it may be slipped onto the rod at any point, with vernier for Chicago jointed leveling rods Nos. 470A and 470B, each.....Code Word, **FORETOP**

No. 472-2S. Fiber Targets, round, for Chicago jointed stadia rods Nos. 471A and 471B, furnished in pairs, one without vernier to clamp at top of rod and one with vernier. Per pair.....Code Word, **FOREWIND**

470A-470B

See price list in back of catalog.

LIETZ PLUMB BOBS



Highest quality, made of brass, nicely finished, with screw caps and hardened steel points. THE CAPS AND POINTS ARE OF UNIFORM SIZE FOR ALL SIZES OF BOBS AND CAN READILY BE INTERCHANGED OR NEW ONES INSERTED.

Number	474	475	476	477	478	479	480	481	482
Weight	6-oz.	8-oz.	10-oz.	12-oz.	14-oz.	16-oz.	18-oz.	24-oz.	32-oz.
Each.....									

Extras for Plumb Bobs

Each

No. 484A. Extra Points	
No. 484C. Extra Caps	

PLUMB-BOB CORD

Per yd.

No. 484A. Best Braided Linen Cord, thick.....
No. 485B. Best Braided Linen Cord, medium.....
No. 485C. Best Braided Linen Cord,, thin.....
No. 486. Best Braided Silk Cord, oiled, medium

Plumb-bob Cord is put up in 25- and 100-yard hanks.



No. 485B

See price list in back of catalog.

PLUMB BOBS AND ACCESSORIES



No. 490



No. 515



No. 516

BOB LINE TARGETS

No. 490. Wuth's Bob Line Target, made of pressed metal, for attaching to plumb-bob line. Painted red and white. Each

IRON BOBS

Each

No. 515. Iron Plumb Bob, 7-oz., black enameled finish.....

LEATHER SCABBARDS FOR PLUMB BOBS

Our Scabbards are made with a leather strip which fits over the top of the bob, insuring it against loss. The back is a heavy piece of flat leather and the point of the bob cannot wear through and injure the user; with belt loop.

Each

No. 516A. Scabbard for plumb bob, 8 to 12-oz.....

No. 516B. Scabbard for plumb bob, 14 to 16-oz.....

No. 516C. Scabbard for plumb bob, 18 to 24-oz.....

No. 516D. Scabbard for plumb bob, 40 to 48-oz.....

When ordering please state weight of bob for which scabbard is intended.



No. 520

No. 520. Plummet Adjuster. By pressing sides of adjuster and moving it up or down the proper length of string the plummet height is quickly secured with one hand, leaving the other hand free to shift the transit head to position over tack or center. The adjuster grips instantly on releasing pressure. No tying or untying of knotted strings. Saves time, trouble and tiresome stooping. Price, each.....

See price list in back of catalog.

ENGINEERS' BUSH KNIVES, HOOKS AND AXES



No. 521



No. 523



Nos. 526 and 526A.

Each

No. 521.	Engineers' Bush Knives for cutting shrubs, brush, and for sharpening stakes. 24-inch blade
No. 521A.	Same as No. 521, in fancy leather sheath.....
No. 522.	Same as No. 521, but 17-inch blade.....
No. 522A.	Same as No. 522, in fancy leather sheath.....
No. 523.	Engineers' Bush Hooks, fitted with long ax handle; weight 3 lbs.
No. 523½.	Short Engineers' Bush Hook.....
No. 524.	Engineers' Axes, with broad head. For pointing and driving stakes, cutting trees, etc. Long handle. Weight 5 pounds.....
No. 525.	Same as No. 524, but weight 3½ pounds.....
No. 526.	Select Quality Hand Ax. Weight 2 pounds.....
No. 526A.	Select Quality Hand Ax, in leather sheath.....

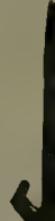
STAKE TACKS AND SURVEYING SPADS



No. 528



No. 531



No. 532

No. 528B.	Stake Tacks, galvanized, tin box of 100.....
No. 528C.	Stake Tacks, galvanized, in one-pound packages.....
	Above Tacks have an indentation in the surface of the head, to guide plumb bob point.
	Surveying Spads, non-corrosive steel, 1½ inches long, for suspending plumb bob from timbers in mines:
No. 531A.	Tin box of 50.....
No. 531B.	In bulk, per 1000.....
	Surveying Spads, hook-shape, steel, 2 inches long:
No. 532A.	Tin box of 50.....
No. 532B.	In bulk, per 1000.....

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

SURVEYORS' ARROWS

The rings are enameled in bright vermillion.



Nos. 534-537



No. 549

- No. 534.** Steel Arrows, extra heavy, nickel plated, 10 inches long. Per set of 11
- No. 535.** Steel Arrows, extra heavy, nickel plated, 14 inches long. Per set of 11
- No. 536.** Steel Arrows, not nickel plated, 10 inches long. Per set of 11
- No. 537.** Steel Arrows, not nickel plated, 14 inches long. Per set of 11
- No. 539.** Steel Arrows, painted red and white alternately every inch, 6 inches long. Per set of 11.....

CARRYING RINGS AND SCABBARDS FOR ARROWS

- No. 545.** Steel Carrying Ring for arrows.....
- No. 547.** Cloth-Covered Scabbard with carrying strap.....
- No. 548.** Leather Scabbard with carrying strap.....
- No. 549.** Leather Scabbard with belt strap.....

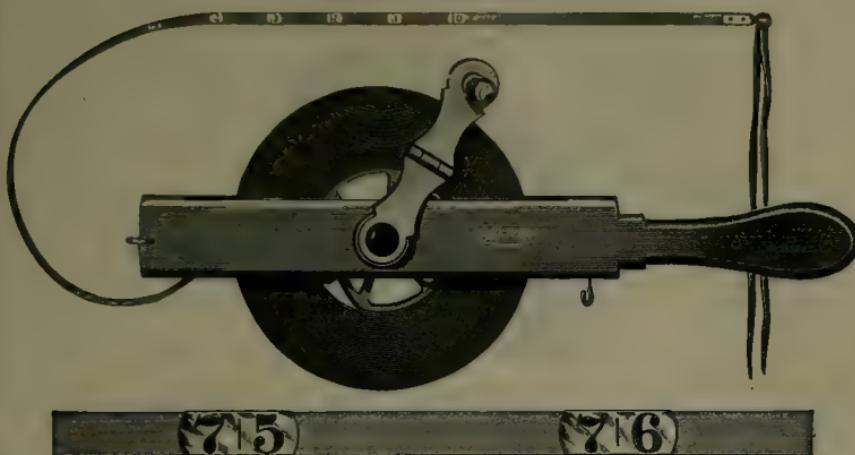
CLOTH FOR SURVEYORS' FLAGS

- No. 550.** Red Cloth. Per yard.....
- No. 551.** White Cloth. Per yard.....

See price list in back of catalog.

SURVEYORS' CHAIN TAPES

Etched Graduations



Heavy $\frac{1}{4}$ -inch steel tape. Nicely finished hardwood reel, with large metal folding handle, and two large detachable rings. Trimmings nicely nickel plated. The graduations on these tapes are etched, and wherever graduated the steel has a bright, raised surface, with the figures etched in. The steel being tempered and of the finest quality the graduations and figures will never be effaced, but will always show up clear and distinct. As a convenient, strong, durable chain tape for heavy field work ours excels all others, and we guarantee it in every way.

Graduations

All chain tapes shown on this page are graduated one side only in feet, every foot, or links and poles every link, as ordered. Tapes graduated in feet have end feet graduated in 100ths of a foot. Tapes graduated in links have end links graduated in tenths of links. Tapes with metric measure are graduated the first decimeter in millimeters, balance of first meter in centimeters, balance of tape in decimeters.

Tapes Complete, with Reel

	Wt. Each	Each
No. 5100.	100 ft.,	$2\frac{1}{2}$ lbs.
No. 5150.	150 ft.,	$3\frac{3}{4}$ "
No. 5200.	200 ft.,	$4\frac{1}{2}$ "
No. 5300.	300 ft.,	$5\frac{1}{2}$ "
No. 5066.	100 links,	2 "
No. 5132.	200 "	$3\frac{1}{2}$ "
No. 5082M.	25 meter,	$2\frac{1}{4}$ "
No. 5100M.	30 "	$2\frac{1}{2}$ "
No. 5164M.	50 "	$3\frac{3}{4}$ "
No. 5328M.	100 "	$5\frac{3}{4}$ "
Reel only		

Tapes Only, with Thongs

	Wt. Each	Each
No. 05100.	100 ft.,	$2\frac{3}{4}$ lbs.
No. 05150.	150 ft.,	3 "
No. 05200.	200 ft.,	$3\frac{3}{4}$ "
No. 05300.	300 ft.,	5 "
No. 05066.	100 links,	$1\frac{3}{4}$ "
No. 05132.	200 "	$2\frac{3}{4}$ "
No. 05082M.	25 meter,	2 "
No. 05100M.	30 "	$2\frac{1}{4}$ "
No. 05164M.	50 "	$3\frac{3}{4}$ "
No. 05328M.	100 "	$5\frac{1}{4}$ "
Thongs only		per pair

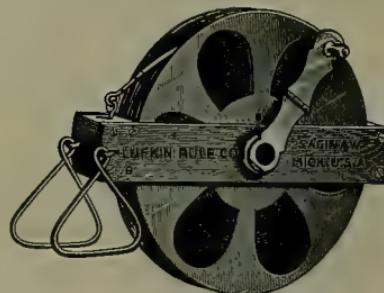
CITY ENGINEERS' CHAIN TAPES

Graduated to 100ths throughout their entire length

No. 5050S.	50 feet in leather case like No. 233.....
No. 5100S.	100 feet, with reel, as shown above.....
No. 05100S.	100 feet, without reel.....
No. 05100SC.	Same as No. 05100S, but fully certified.....

See price list in back of catalog.

MINING ENGINEERS' CHAIN TAPES
ETCHED GRADUATIONS



Tape complete with Reel

7-5

LUFKIN

7-6

Heavy $\frac{1}{8}$ -inch steel tapes, hardwood frame with substantial sheet steel open reel. Large metal folding handle and two detachable rings. One side of frame is provided with a large and convenient leather loop for holding. The graduations on these tapes are etched, and wherever graduated, the steel has a bright, raised surface, with the figures etched in. The steel being tempered and of the finest quality, the graduations and figures will never be effaced, but will always show up clear and distinct.

GRADUATIONS

All chain tapes shown on this page are graduated one side only in feet, every foot, or links and poles every link, as ordered. Tapes graduated in feet have end feet graduated to tenths, and, unless otherwise specified, will be sent end feet in hundredths. Tapes graduated in links have end links graduated in tenths of links. Tapes with metric measure are graduated the first decimeter in millimeters, balance of first meter in centimeters, balance of tape in decimeters.

Tapes Complete, with Reel

Wt. Each. Each

No. 4100.	100 ft.	$3\frac{1}{4}$ lbs.
No. 4150.	150 ft.	$3\frac{3}{4}$ "
No. 4200.	200 ft.	$4\frac{1}{4}$ "
No. 4300.	300 ft.	$5\frac{1}{2}$ "
No. 4500.	500 ft.	7 "
No. 4066.	100 links,	3 "
No. 4132.	200 "	$3\frac{1}{2}$ "
No. 4082M.	25 meter,	3 "
No. 4100M.	30 "	$3\frac{1}{4}$ "
No. 4164M.	50 "	$3\frac{3}{4}$ "
No. 4328M.	100 "	$5\frac{1}{4}$ "
Reel only		

Tapes Only, with Thongs

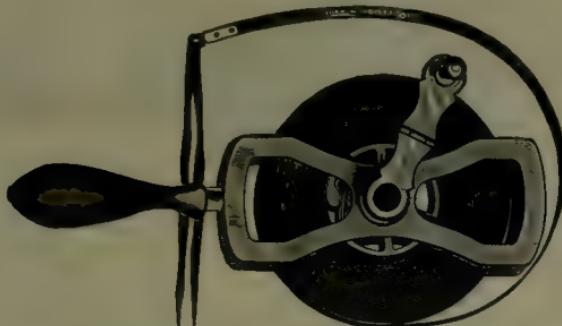
Wt. Each. Each

No. 04100.	100 ft.	$1\frac{3}{4}$ lbs.
No. 04150.	150 ft.	2 "
No. 04200.	200 ft.	$2\frac{1}{4}$ "
No. 04300.	300 ft.	$3\frac{1}{4}$ "
No. 04500.	500 ft.	5 "
No. 04066.	100 links,	$1\frac{1}{2}$ "
No. 04132.	200 "	2 "
No. 04082M.	25 meter,	$1\frac{1}{2}$ "
No. 04100M.	30 "	$1\frac{3}{4}$ "
No. 04164M.	50 "	2 "
No. 04328M.	100 "	$3\frac{1}{2}$ "
Thongs only		per pair

See price list in back of catalog.

CONSTRUCTION ENGINEERS' CHAIN TAPES

Graduated on Babbitt Metal



3 | E | 7 | 4 |

This tape is designed to answer the requirements of the most severe usage, and to take the place of the old-time, yet indestructible, steel chain. It is made of practically unbreakable steel, somewhat heavier than the ordinary chain tape.

Graduations are stamped into Babbitt Metal at each foot, end feet in tenths; or at each link, end links in 10ths of links. Each tape is provided with a pair of detachable handles, or rawhide thongs, as desired.

Special attention is called to this reel, which is built especially for Babbitt Metal tapes. Nickel-plated metal frame, with folding winding handle. A very serviceable reel easily wound and of beautiful finish.

Tapes Complete, with Reel

	3/16 inch wide.	Each
No. 2100.	100 feet	
No. 2150.	150 feet	
No. 2200.	200 feet	
No. 2300.	300 feet	
No. 2500.	500 feet	
No. 2066.	100 links	
No. 2132.	200 links	

	5/16 inch wide.	Each
No. 3100.	100 feet	
No. 3066.	100 links	

Tapes Only, with Thongs

	3/16 inch wide.	Each
No. 02100.	100 feet	
No. 02150.	150 feet	
No. 02200.	200 feet	
No. 02300.	300 feet	
No. 02500.	500 feet	
No. 02066.	100 links	
No. 02132.	200 links	

	5/16 inch wide.	Each
No. 03100.	100 feet	
No. 03066.	100 links	

We can furnish other lengths of 5/16-inch tapes to order.

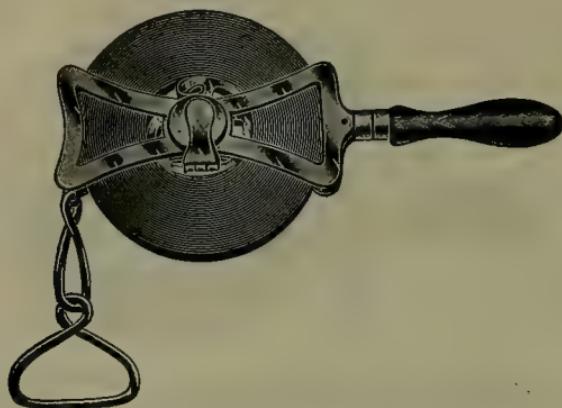
SHOULDERS FOR CHAIN TAPES



Some surveyors use in chaining a tape equipped with shoulders. These shoulders assist in locating the zero and the last graduation. They are carefully soldered to the tape and when so ordered will be supplied on any of our chain tapes. Order by "W. S." Extra, per pair.....

See price list in back of catalog.

CHICAGO STEEL TAPES



Chicago Steel Tapes are made of the best quality flexible steel ribbons carefully tempered to prevent kinking. Made in two widths, 3/16 and 5/16 inch. Plainly divided at every foot, link or meter, end divisions in 10ths. The divisions are deeply stamped on solder and are clear and legible and begin 6 inches from the end. These tapes are made under a ten-pound strain at a temperature of 70° Fahrenheit.

With or without nickel-plated metal frame with folding handle. Each tape supplied with two detachable handles or rawhide thongs, as desired.

Tapes Complete, with Reel

3/16 inch wide
No. 8100. 100 feet
No. 8200. 200 feet
No. 8300. 300 feet
No. 8500. 500 feet
No. 8066. 100 links
No. 8132. 200 links

5/16 inch wide
No. 9050. 50 feet
No. 9100. 100 feet
No. 9200. 200 feet
No. 9300. 300 feet
No. 9066. 100 links
No. 9132. 200 links
No. 9020M. 20 meters
No. 9040M. 40 meters

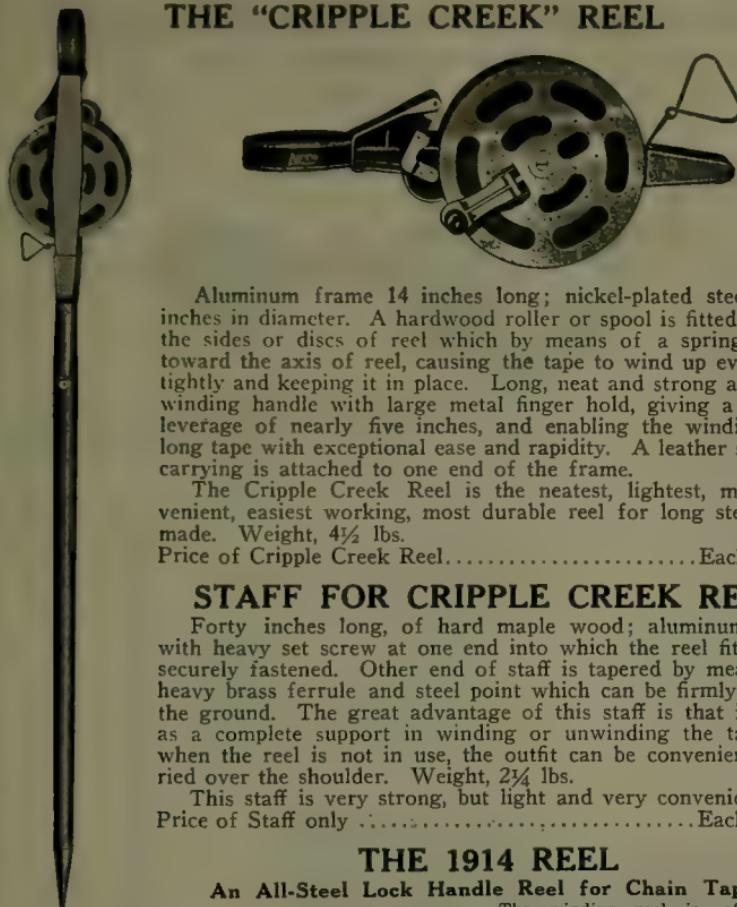
Tapes Only, with Thongs

3/16 inch wide
No. 08100. 100 feet
No. 08200. 200 feet
No. 08300. 300 feet
No. 08500. 500 feet
No. 08066. 100 links
No. 08132. 200 links

5/16 inch wide
No. 09050. 50 feet
No. 09100. 100 feet
No. 09200. 200 feet
No. 09300. 300 feet
No. 09066. 100 links
No. 09132. 200 links
No. 09020M. 20 meters
No. 09040M. 40 meters

We can furnish other lengths of 5/16-inch tapes to order.
Chicago Steel Tapes can be furnished with shoulders, see page 179.

See price list in back of catalog.

THE "CRIPPLE CREEK" REEL

Aluminum frame 14 inches long; nickel-plated steel reel 8 inches in diameter. A hardwood roller or spool is fitted between the sides or discs of reel which by means of a spring presses toward the axis of reel, causing the tape to wind up evenly and tightly and keeping it in place. Long, neat and strong aluminum winding handle with large metal finger hold, giving a winding leverage of nearly five inches, and enabling the winding of a long tape with exceptional ease and rapidity. A leather strap for carrying is attached to one end of the frame.

The Cripple Creek Reel is the neatest, lightest, most convenient, easiest working, most durable reel for long steel tapes made. Weight, $4\frac{1}{2}$ lbs.

Price of Cripple Creek Reel..... Each.....

STAFF FOR CRIPPLE CREEK REEL

Forty inches long, of hard maple wood; aluminum socket with heavy set screw at one end into which the reel fits and is securely fastened. Other end of staff is tapered by means of a heavy brass ferrule and steel point which can be firmly set into the ground. The great advantage of this staff is that it serves as a complete support in winding or unwinding the tape, and when the reel is not in use, the outfit can be conveniently carried over the shoulder. Weight, $2\frac{1}{4}$ lbs.

This staff is very strong, but light and very convenient.
Price of Staff only Each.....

THE 1914 REEL**An All-Steel Lock Handle Reel for Chain Tapes**

The winding reel is of 7 inch diameter and frame in which it is mounted is 14 inches long over all. The winding handle gives 5 inches leverage, and locks into either end of the frame, thus holding the tape at any point. Hardwood spring tension roller engages the tape, causing it to wind evenly and tightly. This reel is in dull nickel plated finish. It is of medium weight and will withstand severe use.

No. 1914 reel can be used with any of our chains, and is especially recommended for the longer lengths and the babbitt tapes. Made in three capacities, varying only in width.

In Ordering Always State Length, Width and Style of the Tape to be Used
No. 1914. Reel, for 100 foot tapes. Weight each, $8\frac{3}{4}$ lbs. Each.....
No. 1914. Reel, for 200 to 300 foot tapes. Weight each, 4 lbs. Each.....
No. 1914. Reel, for 500 foot tapes. Weight each, $4\frac{1}{2}$ lbs. Each.....

See price list in back of catalog.

ENGINEERS' PATTERN FRAME STEEL TAPES

Instantaneous Readings



Metal frames and trimmings, polished hardwood handles, two detachable rings. The tape can be readily detached from frame, and when so detached, the frame can be conveniently carried in pocket.

Tapes less than 100 feet are put up on two-arm frames; tapes 100 feet and longer are put up on four-arm frames.

With One-quarter-Inch Heavy Tapes

Marked Feet and 12ths (Inches and Eighths)	Marked Feet, 10ths and 100ths of feet, for Surveyor's Use	Length	Each
No. 273	No. 273D	50 ft.	
No. 275	No. 275D	75 ft.	
No. 276	No. 276D	100 ft.	

Tapes marked links on back add 1c per foot.

Tapes marked metric on back add 2c per foot.

CLAMP HANDLES



No. 584

For attaching to any part of a long steel tape, thus enabling one to adapt it to any desired length. Brass, nicely nickel plated.

No. 584. Wt. 4 oz..... Each

EXTRA SWIVEL HOOKS AND LEATHER THONGS

- No. 585.** Extra Swivel Hooks for chain tapes..... Each,
No. 586. Extra Rawhide Thongs for chain tapes..... Pair,
For Tape Repair Outfits see pages 194 and 195.

See price list in back of catalog.

ATTACHMENTS FOR ENGINEERS' TAPES

EXTRA DETACHABLE RINGS OR HANDLES

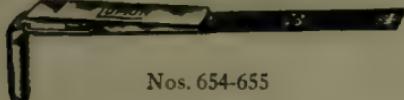
No. 650. 1-in. round Per pair

TAPE HOOKS

For attaching to steel tapes.
Measures from inside of hook.

No. 654. For $\frac{1}{4}$ -inch tapes Each

No. 655. For $\frac{3}{8}$ -inch tapes



Nos. 654-655

This hook when attached to the first end of a steel tape enables one steadily to take long as well as short measurements readily.



No. 650

TENSION HANDLES

For applying exact tension at which a steel tape is standard. Brass, nickel plated.

Capacity.

Diam. and Length. Each

No. 625.	20 lbs. by $\frac{1}{2}$ lbs.	$\frac{5}{8}$ in. by $4\frac{3}{4}$ in...
No. 626.	30 lbs. by $\frac{1}{2}$ lbs.	$\frac{5}{8}$ in. by $4\frac{3}{8}$ in...
No. 627.	40 lbs. by $\frac{1}{2}$ lbs.	$\frac{3}{4}$ in. by 8 in...
No. 628.	50 lbs. by $\frac{1}{2}$ lbs.	$\frac{7}{8}$ in. by 9 in...
No. 629.	60 lbs. by $\frac{1}{2}$ lbs.	$\frac{7}{8}$ in. by $9\frac{1}{2}$ in...

Nos.
625-629



McCULLOUGH TAPE LEVEL



No. 635

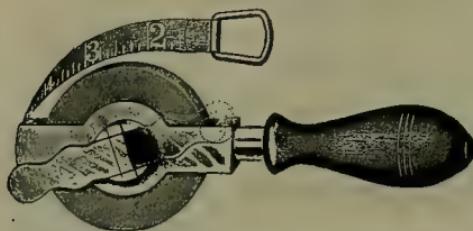
No. 635. McCullough Tape Level insures accuracy in measurements with steel tapes. Above cut full size. Weight, one ounce. It is used by clamping to the tape, about one foot from the handle, by means of the two springs shown, and can be attached and detached instantly. Price

No. 636. Thermometer and Level in nickel-plated case to attach to tape at any point.....
For Pocket Thermometers see pages 140 and 152.

See price list in back of catalog.

LOCK HANDLE FRAME STEEL TAPES

Instantaneous Readings



The frames of these tapes are fitted with a folding lock handle, which folds over the tape, enabling one to stop it at any desired length. This handle, on account of its length, also affords increased winding leverage, which, together with the large knob, makes it especially convenient and easy winding.

With $\frac{1}{4}$ -Inch Engineer's Pattern Tapes, Detachable Rings

Marked Feet and 12ths (Inches and Eighths)	Marked Feet, 10ths and 100ths of feet, for Surveyor's Use	Length	Each
No. 1273	No. 1273D	50 ft.	
No. 1275	No. 1275D	75 ft.	
No. 1276	No. 1276D	100 ft.	

No. 1276, 100-foot Tape listed above, is supplied with 4-arm frame.

With $\frac{3}{8}$ -Inch Tapes, Rings Attached

No. 1280	No. 1280D	25 ft.
No. 1281	No. 1281D	33 ft.
No. 1283	No. 1283D	50 ft.
No. 1284	No. 1284D	66 ft.
No. 1285	No. 1285D	75 ft.
No. 1286	No. 1286D	100 ft.

With $\frac{1}{2}$ -Inch Tapes, Rings Attached

No. 1293	No. 1293D	50 ft.
No. 1296	No. 1296D	100 ft.

Tapes marked metric measure one side only, same price as corresponding length in feet.

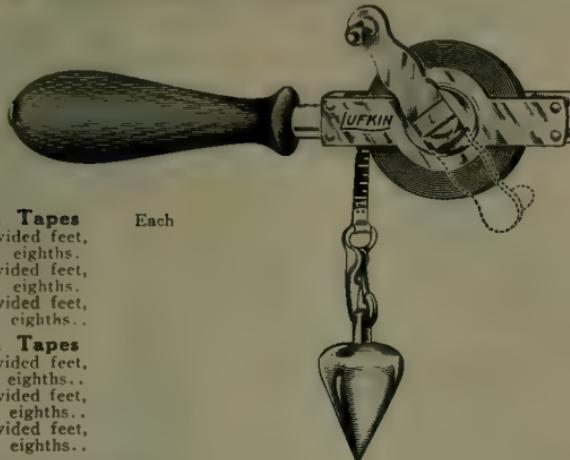
Tapes marked feet one side, metric measure on the other, add 2 cents per foot to list price.

See price list in back of catalog.

OIL MEASUREMENT TAPES

With plumb bob attachment for gauging oil in tanks. This attachment is included in the measurement of the tape supplied. The tapes are provided with a snap for detaching from bob when not in use.

IN LOCK HANDLE FRAMES



With $\frac{1}{4}$ -Inch Tapes

- No. 1270WB. 25 feet, divided feet,
inches and eighths.
No. 1271WB. 33 feet, divided feet,
inches and eighths.
No. 1273WB. 50 feet, divided feet,
inches and eighths.

Each

With $\frac{3}{8}$ -Inch Tapes

- No. 1280WB. 25 feet, divided feet,
inches and eighths.
No. 1281WB. 33 feet, divided feet,
inches and eighths.
No. 1283WB. 50 feet, divided feet,
inches and eighths.

With $\frac{3}{8}$ -Inch Lietz Special Tapes

These tapes are made of Phosphor Bronze.
Guaranteed not to rust or be affected by
acids, etc.

- No. 1280XWB. 25 ft., divided feet, inches and eighths.....
No. 1281XWB. 33 ft., divided feet, inches and eighths.....
No. 1283XWB. 50 ft., divided feet, inches and eighths.....

Each

PLUMB BOBS FOR STEEL TAPES



No. 588



No. 589



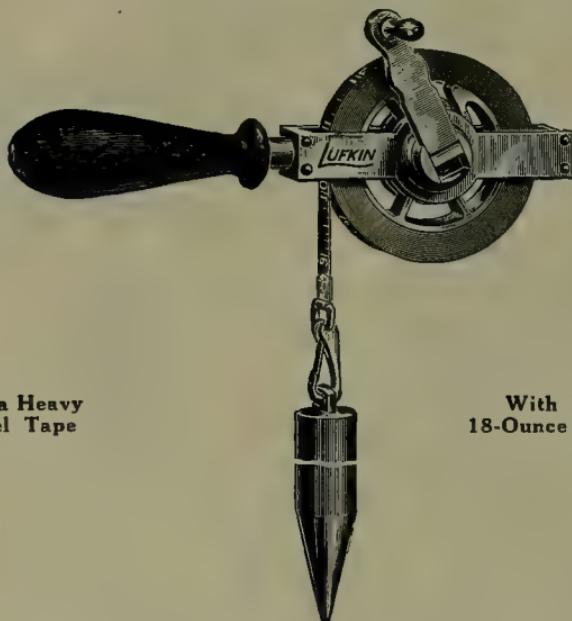
No. 590

These plumb bobs attached to steel tapes are used in tank gauging throughout the oil industry. No. 588 is of weight suitable for gauging the lighter crude oils, gasoline, etc. No. 590 will penetrate the heavier oils. These two bobs are nickel plated and polished. No. 588 is enameled, and being same length as No. 588, is interchangeable with it.

- No. 588. Weight each, 6 ozs. Length, $2\frac{3}{4}$ inch. Diameter, $1\frac{1}{4}$ inch. Each..
No. 589. Weight each, 14 ozs. Length, $2\frac{3}{4}$ inch. Diameter, $2\frac{3}{8}$ inch. Each..
No. 590. Weight each, 18 ozs. Length, $6\frac{1}{4}$ inch. Diameter, 1 inch. Each..

See price list in back of catalog.

OIL GAUGERS' STEEL TAPES
WITH PLUMB BOB



**Extra Heavy
Steel Tape**

**With Pointed
18-Ounce Plumb Bob**

The tapes shown on this page have been especially designed to meet the demand for a practical oil gaugers' steel tape, and one that will withstand a great deal of hard usage. The steel line, which is considerably heavier than used in our regular tapes, is mounted on a strong metal frame of special design and is fitted with a round plumb bob $6\frac{3}{4}$ inches long with tapering point and weighing 18 ounces, which is a weight sufficient to penetrate the heaviest of oils such as those that accumulate an asphalt deposit, etc.

Fitted with a lock handle which folds over the tape, enabling one to stop and hold it at any desired length, and as this handle is extra long and winding drum extra large, it affords increased winding leverage, which, together with the large knob, makes it especially convenient and easy winding. The length of the bob is included in the markings on the tape and the bob is so attached that it can be quickly removed when not in use. Handle of frame is made of hardwood and is nicely polished.

With One-Half Inch Heavy Steel Tape

Marked feet, inches and 8ths one side only.

- No. 1291S.** With pointed Plumb Bob No. 590. Length 33 feet, weight each $2\frac{3}{4}$ lbs. Each
- No. 1293S.** With pointed Plumb Bob No. 590. Length 50 feet, weight each 3 lbs. Each

See price list in back of catalog.

POCKET MEASURING TAPES

LUFKIN STEEL TAPES

Standard of Measurements

Lufkin Steel Tapes are so carefully graduated by standards supplied by the United States Government that they can be used for testing the accuracy of other tapes.

Tension:

Lufkin Steel Tapes are made under a tension of 10 pounds for tapes up to 100 feet in length and 20 pounds if longer. They are accurate when supported full length at this tension.

Temperature:

Steel tapes graduated in customary English units (feet, inches, etc.) are standard at a temperature of 62° Fahrenheit. The National Bureau of Standards recommend tapes graduated in the metric system be made standard at 20° Centigrade, this being the normal temperature under which they are used. We are prepared to make them at 20° Centigrade if so desired, but unless otherwise specified, we will make them accurate at 0° Centigrade, which is the customary standard for countries that have adopted the metric system.

CERTIFICATE OF COMPARISON OF THE NATIONAL BUREAU OF STANDARDS AT WASHINGTON, D. C.

We can furnish a certificate of comparison of the National Bureau of Standards for any Lufkin Steel Tape the graduations of which are marked directly on the steel and the zero of the graduations is represented by a line marked on the tape. The fees of the Bureau of Standards for comparisons are given below, to this must be added the transportation charges to and from Washington, D. C.

- (A) For total length, not greater than 100 feet or 50 meters, either supported throughout or at intervals.....
 - For each additional 100-foot or 50-meter interval.....
 - (D) For comparing total length both supported throughout and at intervals for length of 100 feet or 50 meters.....
 - For each additional 100 feet or 50 meters.....
 - (F) For each sub-division compared.....
 - (G) For determination of length at an additional tension, for each 100-foot or 50-meter interval
 - (H) For determining the tension to the nearest 0.5 pound or 0.25 kilogram at which the tape is most nearly correct at the standard temperature, for each 100-foot or 50-meter interval.....
- For tapes not sent on a reel there will be an additional charge for each 100-foot or 50-meter length or fraction thereof of....

The Bureau of Standards certificate states the temperature at which the comparison was made, the method of support, the tension used in making comparison, and the length corrected for the standard temperature. The number of each certificate is also etched on the tape.

INSTANTANEOUS READINGS



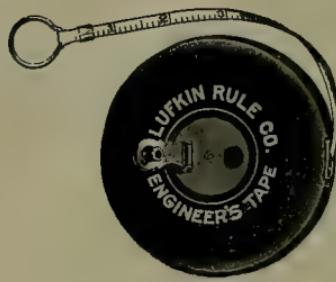
Instantaneous Readings, a patented system of marking steel and metallic tapes, consists of repeating the foot marks at every inch in small, yet easily distinguishable figures. Thus the total reading is brought directly before the eye, eliminating all chance of possible error, and saving valuable time.

See price list in back of catalog.

ENGINEERS' PATTERN STEEL TAPES

Leather Cases

Instantaneous Readings



A sturdy Tape and Case designed for engineering, surveying and other heavy work.

A quarter-inch tape, 50 per cent heavier than standard $\frac{3}{8}$ -inch lines, and put up in steel-lined leather case. It is the width and weight best for heavy work. For carrying, a case tape is by many preferred to a frame tape.

The line, of highest grade tape steel, is distinctly marked, with measurements beginning at end. It is readily removed from case and is supplied with a pair of detachable rings. The case is narrow, of selected genuine russet leather, hand-stitched, with

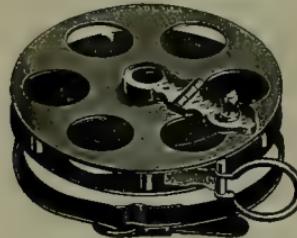
substantial plated steel liner. Folding flush handle is opened by pressing pin on opposite side. Measurements guaranteed accurate.

Marked Feet and 12ths (Inches and Eighths)	Marked Feet, 10ths and 100ths of feet, for Surveyor's Use	Length	Weight Ounces	Each
No. 231	No. 231D	33 ft.	13	
No. 233	No. 233D	50 ft.	17	
No. 234	No. 234D	66 ft.	21	
No. 235	No. 235D	75 ft.	22	
No. 236	No. 236D	100 ft.	27	

Tapes divided metric system on back add 2c per foot.

"WOLVERINE" STEEL TAPES

Instantaneous Readings



Open metal reel, with nickel-plated brass folding handle. Leather strap on the reverse side, by which the tape can be firmly held when winding. This reel is very strong, and is built to withstand the most severe usage. The metal is given a satin finish, which presents a beautiful appearance. With $\frac{3}{4}$ -inch engineers' pattern steel tapes.

Marked Feet and 12ths (Inches and Eighths)	Marked Feet, 10ths and 100ths of feet, for Surveyor's Use	Length	Each
No. 1373	No. 1373D	50 ft.	
No. 1376	No. 1376D	100 ft.	
No. 1377	No. 1377D	150 ft.	

For prices of Lines only, see page 193.

See price list in back of catalog.

"RELIABLE" STEEL MEASURING TAPES

Instantaneous Readings

¾-Inch Tapes



Marked Feet and 12ths (Inches and Eighths)	Marked Feet, 10ths and 100ths of feet, for Surveyor's Use	Length	Each
No. 200	No. 200D	25 ft.	
No. 203	No. 203D	50 ft.	
No. 205	No. 205D	75 ft.	
No. 206	No. 206D	100 ft.	

RELIABLE JUNIOR TAPES

Instantaneous Readings

⅜-Inch Tapes



Marked Feet and 12ths	Marked Feet, 10ths and 100ths	Length	Each
No. 100	No. 100D	25 ft.	
No. 103*	No. 103D*	50 ft.	
No. 105	No. 105D	75 ft.	
No. 106	No. 106D	100 ft.	

*No. 103 can be furnished marked feet and 12ths on one side and feet and 100ths on the back. Order by No. 103DOB.....

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

CHALLENGE STEEL MEASURING TAPES

Instantaneous Readings
¾-Inch Tapes



Marked Feet and 12ths (Inches and Eighths)	Marked Feet, 10ths and 100ths of feet, for Surveyor's Use	Length	Diameter of Case	Each
No. 260	No. 260D	25 ft.	2 1/4 in.	
No. 263*	No. 263D*	50 ft.	3 1/4 in.	
No. 265	No. 265D	75 ft.	4 1/4 in.	
No. 266*	No. 266D*	100 ft.	4 1/2 in.	

*Nos. 263 and 266 can be furnished marked feet and 12ths on one side and feet and 100ths on the back or with metric measure on back.

No. 263DOB. 50 feet (decimals)
No. 263MOB. 50 feet (metric)
No. 266DOB. 100 feet (decimals)
No. 266MOB. 100 feet (metric)

CHALLENGE JUNIOR STEEL MEASURING TAPES

Instantaneous Readings
½-Inch Tapes



Marked Feet and 12ths (Inches and 16ths)	Marked Feet, 10ths and 100ths of feet, for Surveyor's Use	Length	Diameter of Case	Each
No. 1260	No. 1260D	25 ft.	2 1/4 in.	
No. 1263*	No. 1263D*	50 ft.	2 7/8 in.	
No. 1265	No. 1265D	75 ft.	3 3/8 in.	
No. 1266	No. 1266D	100 ft.	3 3/4 in.	

*No. 1268 can be furnished marked feet and 12ths on one side and feet and 100ths on the back or with metric measure on back.

No. 1263DOB. 50 feet (decimals)
No. 1263MOB. 50 feet (metric)

See price list in back of catalog.

"RIVAL" STEEL MEASURING TAPES

Instantaneous Readings
 $\frac{1}{8}$ -Inch Tapes



Nickel-plated steel cases, folding flush handle, opened by pressing pin on opposite side. Cases have knurled edges, which afford a firm hold when winding in tape. Measurements guaranteed accurate.

Marked Feet and 12ths (Inches and Eighths)	Marked Feet, 10ths and 100ths of feet, for Surveyor's Use	Length	Each
No. 240	No. 240D	25 ft.	
No. 243	No. 243D	50 ft.	
No. 246	No. 246D	100 ft.	

"RIVAL JUNIOR" STEEL MEASURING TAPES

Instantaneous Readings
 $\frac{1}{4}$ -Inch Tapes



Marked Feet and 12ths (Inches and Eighths)	Marked Feet, 10ths and 100ths of feet, for Surveyor's Use	Length	Each
No. 1240	No. 1240D	25 ft.	
No. 1243	No. 1243D	50 ft.	
No. 1246	No. 1246D	100 ft.	

RIVAL TAPES WITH DIAMETER MEASUREMENTS

These tapes are marked on one side in feet, inches and 8ths, other side with diameter measurements in feet, enabling one, by measuring the circumference, to arrive at the exact diameter as fine as 64ths of inches.

No. 241P.	"Rival," 33 feet with diameter measurement.....
No. 243P.	"Rival," 50 feet with diameter measurement.....
No. 1243P.	"Rival Junior," 50 feet with diameter measurement.....
No. 241XP.	Lietz Special Non-Rust, Non-Breakable Tape, in "Rival" case, 33 feet, with diameter measurement.....
No. 243XP.	Like No. 241XP, but 50 feet.....

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

"BANNER" STEEL MEASURING TAPES

Instantaneous Readings
 $\frac{3}{8}$ -Inch Tapes

Cases made of steel, covered with handsome mottled black "Autoleather," extremely durable. Fitted with folding flush handle, opened by pressing button on opposite side. Trimmings nickel plated.

Graduated in Feet, Inches and Eighths only

No. 550.	25 feet	Each
No. 556.	100 feet	.....
No. 553.	50 feet	.....



POCKET SPRING STEEL TAPES

$\frac{1}{4}$ -Inch Tapes



Round Edge Nickel-Plated Brass Cases, Spring Wind, Center Stop

Marked One Side Only; Inches and 16ths

No. 143.	36 inches, $\frac{1}{4}$ -inch Tape	.....	Each
No. 145.	60 "	$\frac{1}{4}$ " "	"
No. 146.	72 "	$\frac{1}{4}$ " "	"
No. 148.	96 "	$\frac{1}{4}$ " "	"

Marked Inches and 16ths One Side; Feet, 10ths and 100ths Other Side.

No. 143D.	36 inches, $\frac{1}{4}$ -inch Tape	.....	Each
No. 145D.	60 "	$\frac{1}{4}$ " "	"
No. 146D.	72 "	$\frac{1}{4}$ " "	"
No. 148D.	96 "	$\frac{1}{4}$ " "	"

Marked Inches and 16ths One Side; Millimeters Other Side.

No. 143EM.	36 inches, 1 meter, $\frac{1}{4}$ -inch Tape	Each
No. 145EM.	60 " $1\frac{1}{2}$ " $\frac{1}{4}$ " "	"
No. 146EM.	72 " 2 " $\frac{1}{4}$ " "	"

No. 148EM.	96 " $2\frac{1}{2}$ " $\frac{1}{4}$ " "	"
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POCKET STEEL TAPES WITH ARCHITECTS' SCALES

For quickly measuring scale-drawings or blue prints of buildings, plans, etc.

Tapes of best quality steel, $\frac{1}{4}$ inch wide, in "Nubian" Finish. The cases are nickel plated and polished. They are round-edge pattern, spring-wind with center stop.	
No. 391.	60-inch, marked in $\frac{1}{8}$ inch architect's scale, 1 to 480, one side; inches to 16ths other side
No. 392.	60-inch, marked in $\frac{1}{4}$ inch architect's scale, 1 to 240, one side; inches to 16ths other side
No. 393.	60-inch, marked in $\frac{1}{8}$ inch architect's scale one side; $\frac{1}{4}$ inch architect's scale other side

See price list in back of catalog.

**TEMPERATURE SCALE**

For the most exact results the temperature in which a measuring tape is actually used must be taken into account.

Temperature scale on a steel tape is a series of graduations at the last end corresponding to the expansion and contraction of the tape over a range of temperatures which are indicated opposite the various lines. (Above illustration shows such scale (half size) on a 100-foot tape graduated to feet, 10ths and 100ths.) This scale takes the place of the terminal mark, that point falling on the line in the scale representing the temperature prevailing.

We are prepared to put this scale on all steel tapes $\frac{1}{4}$ -inch and over in width, on the basis of the Fahrenheit thermometer for tapes in English markings, and the Centigrade thermometer for those in metric.

Extra for Temperature Scale..... per tape.

STEEL TAPE LINES WITHOUT CASES OR FRAMES**With Regular Graduations**

Specify as "Tapes only" and by prefixing zero to stock number of complete tape, as "No. 0263 Challenge tape only."

Three-Eighths Inch Wide

For No. 200 Series "Reliable," No. 260 Series "Challenge," "Rival," and No. 280 and No. 1281 Series Frame Tapes.

Length, feet ..	25	33	50	66	75	..	100	150	..	200
" meters ..	5	..	10	15	20	..	25	30	..	50
Marked, one side, each ..	..	..	..	..	..	..	..	..	..	..
Marked, both sides, each ..	..	..	..	..	..	..	..	..	..	..

Light Weight, One-Quarter Inch Wide

For "Reliable Jr.," "Challenge Jr.," and "Rival Jr." Tapes.

Length, feet ..	..	25	33	50	66	75	..	100
Length, meters ..	5	..	10	15	20	..	25	30
Marked, one side, each ..	..	..	..	..	..	..	..	..
Marked, both sides, each ..	..	..	..	..	..	..	..	..

Heavy, One-Quarter Inch Wide (with Detachable Rings)

For "Wolverine," and Nos. 231, 273 and 1273 Series Engineers' Pattern Tapes.

Length, feet ..	33	50	66	75	..	100	150	..	200
Length, meters ..	10	15	20	..	25	30	..	50	60
Marked, one side, each ..	..	..	..	..	..	..	..	..	..
Marked, both sides, each ..	..	..	..	..	..	..	..	..	..

Oil Gauge One-Half Inch Wide

Standard Pattern with Snap.

Length, feet ..	..	..	..	..	..	..	33	50
Length, meters ..	..	..	..	..	..	..	10	15
Marked, one side, each ..	..	..	..	..	..	..	..	..
Marked, both sides, each ..	..	..	..	..	..	..	..	..

NOTE—For Chain Tapes only, see Chain Tape pages.

REPAIRS TO STEEL TAPES

We are prepared to give prompt and satisfactory service.

A—Repairing Pocket Tapes—per break.

B—New End Ring, ordinary type.

C—New End Ring, engineers' pattern.

D—Extra Tape furnished, per foot.

E—Repairing Band Chains, per break.

F—New End Ring for band chains.

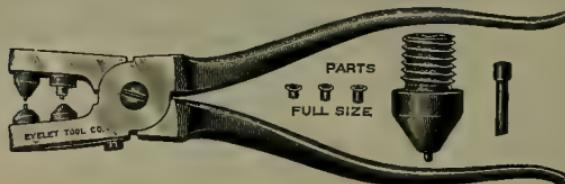
G—Extra Tape furnished, per foot.

*Pocket Spring Steel Tapes cannot be mended except at ends.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

TAPE REPAIRING OUTFITS

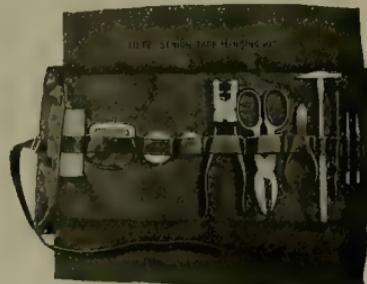


No. 675

Eyelet Punch and Set combined for repairing steel tapes: Tool, socket, punching pin and three sizes eyelets, shorts, longs and extra longs. Cuts clean hole through pocket steel tapes or hand chains without drawing temper; no filing required except to round off the rough corners of the break. Cut first hole, place eyelet on pivot and insert in hole cut, and it is riveted quickly. Five minutes required to make a repair.

Each

No. 675.	Tape Mending Outfit complete, with 1M assorted eyelets..
No. 675A.	Extra Eyelets (when ordering state if Shorts or Longs are wanted), 500 in a package. Price per 1000.....
No. 675B.	Extra Male Punching Dies.....
No. 675C.	Extra Male Setting Dies.....
No. 675D.	Extra Female Dies
No. 675E.	Extra Punching Pins.....
No. 675F.	Extra Escutcheon Pins. Per oz.....
No. 675G.	Three-in-One Oil



SPECIAL LIETZ TAPE REPAIRING OUTFIT

No. 680. The Lietz Senior Outfit will repair any band chain or tape; contains a Mender No. 675 complete, one extra male die No. 675B, 2 extra punch pins No. 675E, escutcheon pins, 1 dozen assorted Lucas tape splices with 1 tube of solder, 1 pair of heavy snips, 1 5-inch file, riveting set and center punch, cutting pliers, hammer, steel anvil, cloth, oil and extra pieces of tape, all in neat Pegamoid pouch. Complete

See price list in back of catalog.

QUICK TAPE REPAIR BANDS



No. 685. "Lucas" Quick Tape Repair Bands furnished with "Lucas" special flux, recommended to be most satisfactory as soldering material does not deteriorate, packed one dozen in a box for 1/8, 3/16, 15/64, 1/4, and 5/16-inch tapes. State width desired when ordering.

Price per box, with tube of solder.....

Be sure to specify size wanted.

No. 685A. Extra Solder, per tube.....

No. 686. Eureka Tape Repair Bands, one dozen in small wooden box for 1/8, 3/16, 1/4, 3/8, 1/2-inch tapes. State width desired when ordering. These splices are coated with a combination of solder and flux, and a lighted match will bring about perfect adhesion between the tape and sleeve.

Price per box

Be sure to specify size wanted.

TAPE SPLICES



No. 690

No. 690. "Little Giant" Tape Splice for 1/8, 3/16, 1/4, 5/16, 3/8, 15/64 and 1/2-inch tapes. Each

To repair breaks insert broken ends, adjust by sight hole and turn down screws. Will withstand strongest pull.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

METALLIC MEASURING TAPES

Flush Handle
Instantaneous Readings
 $\frac{5}{8}$ -Inch Tapes



Hard leather cases, double folding flush handle, opened by pressing pin on opposite side. Tape $\frac{5}{8}$ -inch wide, made of best woven linen, with metallic warp. We guarantee our metallic tapes to be the best, and less liable to shrink or stretch than any others.

Marked One Side, Feet and 12ths	Marked One Side, Feet and 10ths	Length	Each
No. 603	No. 603D	50 ft.	
No. 606	No. 606D	100 ft.	

JUNIOR METALLIC MEASURING TAPES

Flush Handle
 $\frac{3}{8}$ -Inch Tapes

Hard leather cases, nickel-plated trimmings, double folding flush handle, opened by pressing pin on opposite side. Tape is made of best woven linen with metallic warp. Marked one side only in 10ths or 12ths.

The Junior Metallic is a companion to our popular "Reliable Junior" and is less than one-half the size and weight of a regular metallic tape.

Marked One Side, Feet and 12ths	Marked One Side, Feet and 10ths	Length	Each
No. 660	No. 660D	25 ft.	
No. 663	No. 663D	50 ft.	

POCKET LINEN TAPES

**Round Edge Nickel-Plated Brass Cases, Spring Wind, Center Stop
With One-quarter-Inch Enameled Linen Tapes**

Marked Inches and 8ths One Side Only.	Each
No. 173. 36 inches	
No. 175. 60 inches	
No. 176. 72 inches	

See price list in back of catalog.

METALLIC MEASURING TAPESFolding Handle— $\frac{5}{8}$ -Inch Tapes. Instantaneous Readings

Hard leather cases, folding handles, nickel-plated trimmings. Tape $\frac{5}{8}$ inch wide, made of best woven linen with metallic warp. We guarantee our Metallic Tapes to be less liable to shrink or stretch than any others.

Marked One Side Only

Marked Feet and 12ths	Marked Feet and 10ths	Length	Each
No. 500	No. 500 D	25 ft.	
" 503	" 503 D	50 "	
" 505	" 505 D	75 "	
" 506	" 506 D	100 "	

Marked Two Sides

Feet and 10ths, and Links on back	Feet and 12ths, and Centimeters on back	Length	Each
No. 503 DL	No. 503 ME	50 ft. or 15 meters	
" 506 DL	" 505 $\frac{1}{2}$ ME " 506 ME	25 " 100 ft. or 30 "	

Tapes marked with feet on back instead of links, or with any two measurements listed above, will be supplied at prices of corresponding tapes marked both sides.

METALLIC TAPE REFILLS**JUNIOR METALLIC TAPE LINES ONLY, WITHOUT CASES** **$\frac{5}{8}$ Inch Wide**

Marked Feet and 12ths	Marked Feet and 10ths	Length	Each
No. 0660	No. 0660 D	25 ft.	
" 0663	" 0663 D	50 "	

METALLIC TAPE LINES ONLY, WITHOUT CASES **$\frac{5}{8}$ Inch Wide—Marked One Side Only**

Marked Feet and 12ths	Marked Feet and 10ths	Marked Metric	Length Feet	Length Meters	Each
No. 0500	No. 0500D	.....	25	.....
" 0503	" 0503D	0503M	50	15	
" 0505	" 0505D	.....	75	.....
" 0506	" 0506D	0505 $\frac{1}{2}$ M 0506M	..... 100	25 30	

Marked Two Sides

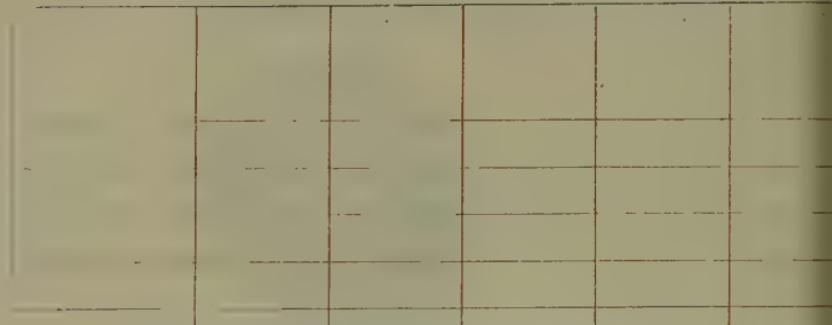
Marked Feet and 10ths, Links on back	Marked Feet and 12ths, Centi- meters on back	Length Feet	Length Meters	Each
No. 0500 DL	.....	25	.....
" 0503 DL	No. 0503 ME	50	15	
" 0505 DL	.....	75	.....
" 0506 DL	" 0505 $\frac{1}{2}$ ME " 0506 ME	..... 100	25 30	

See price list in back of catalog.

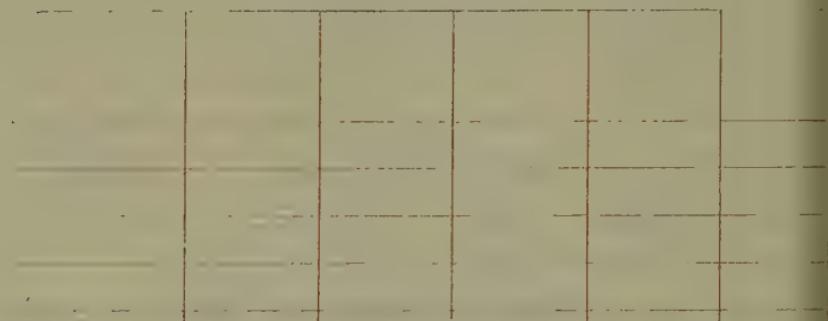
THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

ALCO ENGINEER

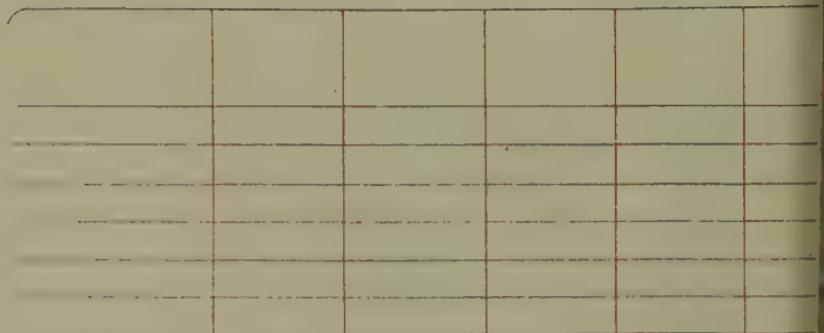
All of our Field Books contain stadia reduction tables, naturals and other handy tables.



- No. 760. Field Book, $4\frac{1}{2} \times 7\frac{1}{4}$ in., 80 leaves.
No. 761. Field Book, $4\frac{1}{2} \times 7\frac{1}{4}$ in., 60 leaves.
No. 762. Field Book, $4 \times 6\frac{1}{2}$ in., 80 leaves.



- No. 763. Mining Transit Book, $4\frac{1}{2} \times 7\frac{1}{4}$ in., 80 leaves, right-hand page $8 \times$ inch.



- No. 764. Engineers' Field Book, $4\frac{1}{2} \times 7\frac{1}{4}$ in., 80 leaves, right-hand page 10×10 to the inch.

WE MAKE SPECIAL FIELD BOOKS OF ANY D
See price list in back of catalog.

MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS

THE A. LIETZ COMPANY

SAN FRANCISCO, U. S. A.

LD BOOKS

re well bound in strong leather covers, have sewed backs with cloth reinforcement
nt.

	Per doz.	Each
.....	Per doz.	Each
.....	Per doz.	Each
.....	Per doz.	Each

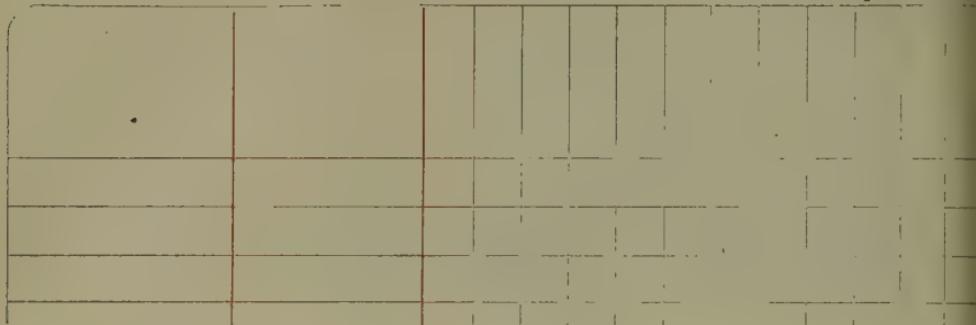
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5th line heavy.....	Per doz.	Each
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RDER AND WILL BE PLEASED TO QUOTE PRICES.

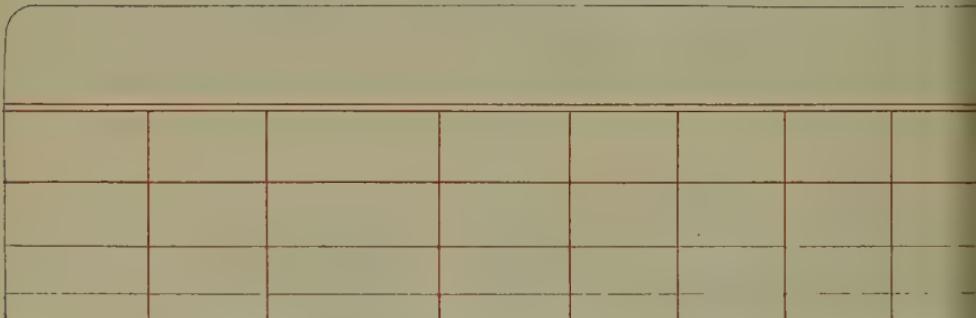
THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

ALCO ENGINEER



No. 766. Topographical Book, $4\frac{1}{2} \times 7\frac{1}{4}$ in., 80 leaves, 2 columns, and balance of page 4 columns.

NOTE—This book is used so that the long 1



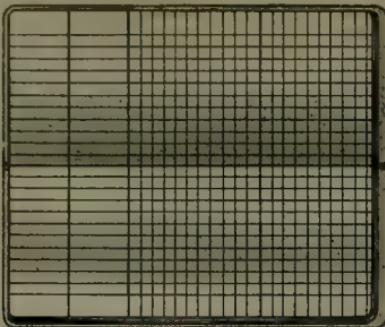
No. 768. Topographical Book, 5x8 in., 80 leaves, right-hand page 4x4 to the inch.



No. 770. Level Book, $4 \times 6\frac{1}{2}$ in., 80 leaves.
No. 772. Level Book, $4\frac{1}{2} \times 7\frac{1}{4}$ in., 80 leaves.
No. 773. Level Book, $4\frac{1}{2} \times 7\frac{1}{4}$ in., 60 leaves.

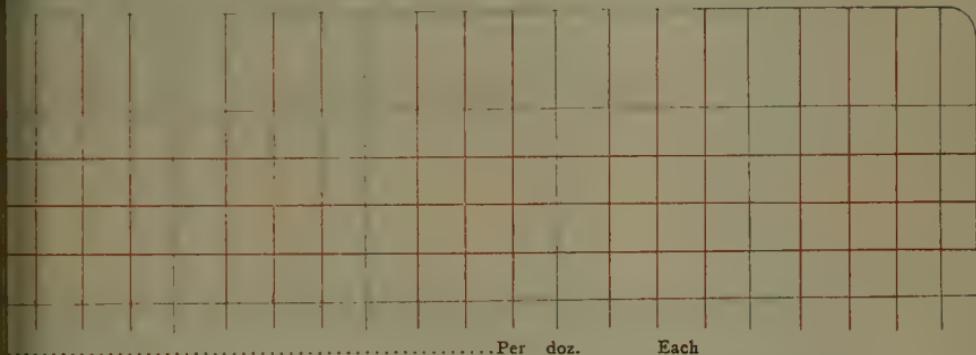
All our Field Books contain
See price list in back of catalog.

FIELD BOOKS

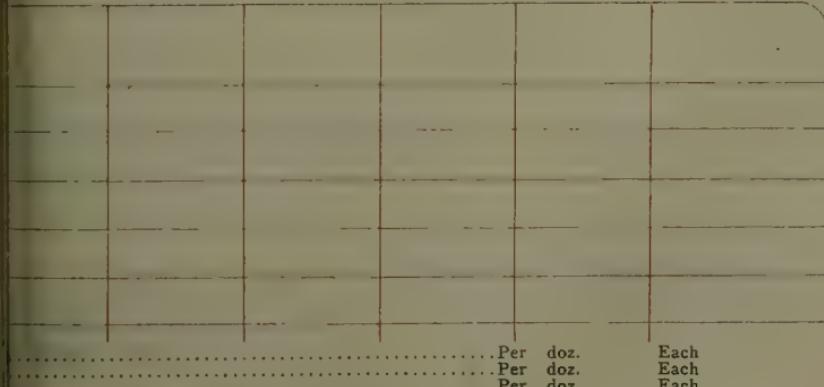


..... Per doz. Each

horizontal. See illustration to the right.



..... Per doz. Each



..... Per doz.
..... Per doz.
..... Per doz.

Each
Each
Each

tion tables, naturals, etc.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

ALCO ENGINEER

SECTION

STA.	ELEVA.	GRADE	CUT OR FILL		
			LEFT	C	RIGHT

No. 774. Earthworks Book, 5x8 in., 80 leaves.....

H. I.	Inst. Station	Back Sight	ANGLE		Needle	Vert. Angle	B I
			Right	Double			

No. 775. Mining Record Book, 5x8 in., 80 leaves.....

No. 777. Cross-section Book, 4½x7½ in., 80 leaves, 10x10 to the inch.....
 No. 778. Cross-section Book, 5½x7½ in., 80 leaves, 10x10 to the inch.....
 No. 779. Cross-section Book, 6½x8½ in., 80 leaves, 10x10 to the inch.....

All our Field Books contain

WE MAKE SPECIAL FIELD BOOKS OF ANY DI

See price list in back of catalog.

OLD BOOKS

AREAS

CUBIC YDS.

REMARKS

EXCAVATION

EMBANKMENT

EXCAV.

EMBANK.

..... Per doz.

Each

Cal.
CourseHor.
Dist.Vert.
Dist.Elev.
F. S.Fore
Sight

REMARKS

..... Per doz.

Each

..... Per doz.

Each

..... Per doz.

Each

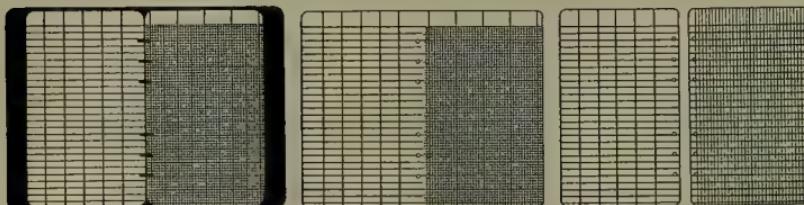
Each

ion tables, naturals, etc.

RDER AND WILL BE PLEASED TO QUOTE PRICES.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

LOOSE LEAF ENGINEERS' FIELD BOOKS



Loose Leaf Field Books are advantageous to engineers in many respects. They enable one to leave finished notes in the drafting room while the books are still being used in the field and to remove certain leaves if necessary. We offer the profession the following assortment. Our Field Binder No. 790 has genuine leather cover and is very durable. Field Binder No. 790F is covered with Fabrikoid, an extremely tough imitation leather. The mechanism is strong and consists of six metal rings which are readily opened when necessary. The Office Binder No. 791 is made of strong cloth covered material with similar mechanism. It is intended for use in the office and for filing sheets. This binder can also be used in the field and has proven very satisfactory for this purpose. The leaves are ruled on extra heavy stock and are similar in design and colors to our regular field books.

COVERS

Each

- No. 790. Heavy Leather-Covered Binder, $7\frac{1}{4} \times 4\frac{1}{2}$ with $\frac{1}{2}$ -inch rings
No. 790F. Fabrikoid-Covered Office Binder, $7\frac{1}{4} \times 4\frac{1}{2}$ with $\frac{1}{2}$ -inch rings
No. 791. Cloth-Covered Office Binder, $7\frac{1}{4} \times 4\frac{1}{2}$ with $\frac{1}{2}$ -inch rings..

Loose Leaf Filing Cabinets listed on the next page.

For Celluloid Field Books or Cruisers' Pads especially adapted
for work in wet weather see page 129.

LOOSE LEAF SHEETS

Loose leaves can be furnished in two styles, single sheets and double sheets. Single sheets are ruled on both sides and are used consecutively. Double sheets are ruled on one side only and the left and right hand pages of each record are joined.

- No. 0760. Single Loose Leaf Sheets like Field Book No. 760. Per 100.....
No. 0760D. Double Loose Leaf Sheets like Field Book No. 760. Per 100.....
No. 0763. Single Loose Leaf Sheets like Field Book No. 763. Per 100.....
No. 0763D. Double Loose Leaf Sheets like Field Book No. 763. Per 100.....
No. 0764. Single Loose Leaf Sheets like Field Book No. 764. Per 100.....
No. 0764D. Double Loose Leaf Sheets like Field Book No. 764. Per 100.....
No. 0772. Single Loose Leaf Sheets like Level Book No. 772. Per 100.....
No. 0772D. Double Loose Leaf Sheets like Level Book No. 772. Per 100.....
No. 0777. Single Loose Leaf Sheets like Field Book No. 777. Per 100.....
No. 0777D. Double Loose Leaf Sheets like Field Book No. 777. Per 100.....

GUMMED MUSLIN EYELETS

- No. 798. Muslin Eyelets, gummed, for reinforcing holes of loose leaf sheets. Per
100

See price list in back of catalog.

FILING CASES FOR LOOSE LEAF SHEETS



No. 800

No. 800. Agate Filing Case, 11 $\frac{1}{2}$ inches long outside, made of heavy binders' board with wood bottom, fitted with a steel follower which by slight pressure of lever can be released and moved forward or backward without friction. Equipped with 25 blank index cards 5x8.....



No. 804



No. 805

No. 802. Peerless Filing Case, 10 inches long, hardwood, either oak or mahogany finish. Substantially made with lock-joint corners. Each tray fitted with steel follower and with quadrants for supporting lid. Equipped with 25 blank index cards 5x8. Oak finish

No. 802M. Mahogany finish ...

No. 804. Utility Filing Case, single-drawer section, 12 $\frac{1}{2}$ inches deep outside, quartered oak, wax finish, durably built with lock joint corners, fitted with steel enameled follower. Furnished with 25 blank index cards 5x8

No. 805. Utility Filing Case, two-drawer section, 12 $\frac{1}{2}$ inches deep outside. Complete with 25 blank index cards as No. 804.....

TRAVERSE SHEETS

- No. 807.** Tabling or Traverse Sheets, 9 $\frac{1}{2}$ x12 inches—20 vertical columns, with printed headings.....
- No. 808.** Tabling or Traverse Sheets, 11x16 inches—14 vertical columns, with printed headings.....
Samples sent on application.

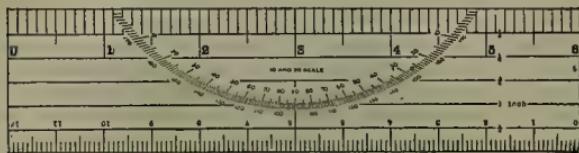
Per 100 Doz.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

FIELD BOOK ACCESSORIES

TRANSPARENT AMBER PROTRACTORS



Each

- No. 2260. Amber Parallel Ruler and Scale Protractor, 10x50 scales....
No. 2261. Amber Parallel Ruler and Scale Protractor, 30x40x50 scales.
No. 2262. Amber Parallel Ruler and Scale Protractor, 20x40 scales...
No. 2263. Amber Parallel Ruler and Scale Protractor, inch and metric scales
No. 2264. Amber Parallel Ruler and Scale Protractor, inch and 10 scales
No. 2265. Amber Parallel Ruler and Scale Protractor, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$ and 1-inch scales

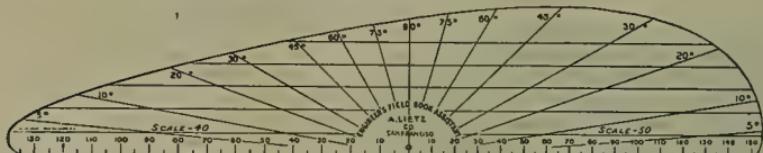
Above Protractors are made of transparent amber, 6 inches long. They combine the advantages of the scale and the protractor. Lines can be drawn at any desired angle or parallel to each other without measuring. Excellent for field book use. Can also be used for inscribing arcs or circles.

TRANSPARENT PLOTTING PROTRACTORS



- No. 2255. Transparent Plotting Protractor, with arms 8 in. long; each.

ENGINEERS' FIELD BOOK ASSISTANT



The Engineers' Field Book Assistant combines in itself a straight-edge, irregular curve, parallel ruler, protractor and scale. Made of thin transparent amber, about $6\frac{1}{2}$ inches long.

- No. 2256. Engineers' Field Book Assistant; each.....

FIELD BOOK PENCILS



- No. 3778. Drawing Pencils, flat, for use in field books, HB, 2H or 4H; dozen

See price list in back of catalog.

ENGINEERS' FIELD BAGS



No. 815

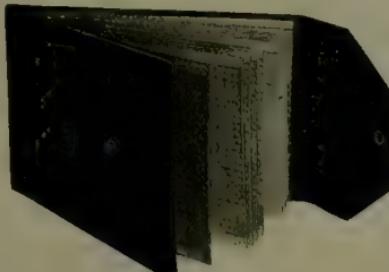
- No. 815.** Leather Carrying Bag for surveyors, 9x7x2½, with three compartments, each
- No. 816.** Canvas Carrying Bag for surveyors, 9x7x2½, with two compartments, each

STRAPS FOR CARRYING STAKES

- No. 820.** Webb Carrying Straps for carrying stakes, with buckle.....

PROFILE BOOKS

- Nos. 825-26.** Continuous. Bound in flexible morocco covers. These books are folded like a map to replace the continuous rolls of profile paper, and the pages are mounted on muslin. Each leaf or two pages facing contain



No. 825

six thousand feet—a "Section" as generally laid out for the construction of a road. Paper is of good quality and lies flat.

- No. 825.** Plate A. 4x20 to one inch. 5½x8 inches. Printed in green.
Each 12 25 50 100 miles
- No. 826.** Plate B. 4x30 to one inch. 4¾x8 inches. Printed in green.
Each 12 25 50 100 miles

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

ALCO PROFILE PAPERS AND CLOTHS

Continuous in Rolls

Our Profile Papers are printed on the best grade of paper. Will stand erasing well and they are superior in accuracy and clearness of lines.

Our Profile Tracing Cloth is printed on the Imperial Brand Cloth.

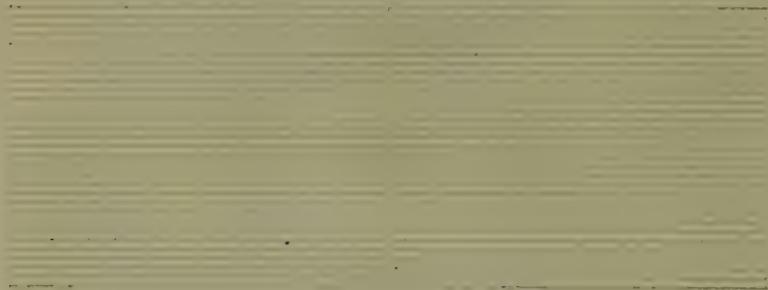


Plate A, 4x20 to One Inch.

Per Roll Per Yd.

No. 840G.	Green, 20 in. wide, Drawing Paper, 50-yd. rolls
No. 840O.	Orange, 20 in. wide, Drawing Paper, 50-yd. rolls
No. 840½G.	Green, 10 in. wide, Drawing Paper, 50-yd. rolls
No. 840½O.	Orange, 10 in. wide, Drawing Paper, 50-yd. rolls
No. 841G.	Green, 20 in. wide, Mounted on Muslin, 20-yd. rolls
No. 841O.	Orange, 20 in. wide, Mounted on Muslin, 20-yd. rolls
No. 842O.	Orange, 20 in. wide, Tracing Paper, 50-yd. rolls
No. 842½O.	Orange, 10 in. wide, Tracing Paper, 50-yd. rolls
No. 843G.	Green, 20 in. wide, Drawing Cloth, 20-yd. rolls
No. 843O.	Orange, 20 in. wide, Drawing Cloth, 20-yd. rolls
No. 844G.	Green, 20 in. wide, Tracing Cloth, 20-yd. rolls
No. 844O.	Orange, 20 in. wide, Tracing Cloth, 20-yd. rolls
No. 844½O.	Orange, 10 in. wide, Tracing Cloth, 20-yd. rolls

PROFILE-PLAN PAPERS AND CLOTHS

Plate A, 4x20 to One Inch.

Width of paper same as our 20-inch papers, but ruling only 10 inches wide, leaving the other half blank for sketching and for explanatory notes. A very convenient paper as it saves referring to several maps for the desired information.

Per Roll Per Yd.

No. 846G.	Green, Drawing Paper, 50-yard rolls.....
No. 846O.	Orange, Drawing Paper, 50-yard rolls.....
No. 847O.	Orange, Tracing Paper, 50-yard rolls.....
No. 848G.	Green, Tracing Cloth, 20-yard rolls.....
No. 848O.	Orange, Tracing Cloth, 20-yard rolls.....

Samples of any of our Papers sent on application.

See price list in back of catalog.

ALCO PROFILE PAPERS AND CLOTHS
Continuous in Rolls

Plate B, 4x30 to One Inch.

	Per Roll Per Yd.
No. 850G. Green, 20 in. wide, Drawing Paper, 50-yd. rolls	
No. 850O. Orange, 20 in. wide, Drawing Paper, 50-yd. rolls	
No. 850½G. Green, 9 in. wide, Drawing Paper, 50-yd. rolls	
No. 850½O. Orange, 9 in. wide, Drawing Paper, 50-yd. rolls	
No. 851G. Green, 20 in. wide, mounted on Muslin, 20-yd. rolls	
No. 851O. Orange, 20 in. wide, mounted on Muslin, 20-yd. rolls	
No. 852O. Orange, 20 in. wide, Tracing Paper, 50-yd. rolls	
No. 852½O. Orange, 9 in. wide, Tracing Paper, 50-yd. rolls	
No. 853G. Green, 20 in. wide, Drawing Cloth, 20-yd. rolls	
No. 853O. Orange, 20 in. wide, Drawing Cloth, 20-yd. rolls	
No. 854G. Green, 20 in. wide, Tracing Cloth, 20-yd. rolls	
No. 854O. Orange, 20 in. wide, Tracing Cloth, 20-yd. rolls	
No. 854½O. Orange, 10 in. wide, Tracing Cloth, 20-yd. rolls	

PROFILE-PLAN PAPERS AND CLOTHS

Plate B, 4x30 to One Inch

20-inch stock, but ruled only 9 inches, leaving other half blank for sketching, etc.

	Per Roll Per Yd.
No. 856G. Green, Drawing Paper, 50-yd. rolls.....	
No. 856O. Orange, Drawing Paper, 50-yd. rolls.....	
No. 857O. Orange, Tracing Paper, 50-yd. rolls.....	
No. 858G. Green, Tracing Cloth, 20-yd. rolls.....	
No. 858O. Orange, Tracing Cloth, 20-yd. rolls.....	

Samples of any of our papers sent on application.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

ALCO CROSS SECTION PAPERS AND CLOTHS
Continuous in Rolls



10x10 to 1 Inch.

Per Roll. Per Yd.

No. 860G.	Green,	20 in. wide,	Drawing Paper, 50-yd. rolls .....	.....
No. 860O.	Orange,	20 in. wide,	Drawing Paper, 50-yd. rolls .....	.....
No. 861G.	Green,	20 in. wide,	Mounted on Muslin, 20-yd. rolls .....	.....
No. 861O.	Orange,	20 in. wide,	Mounted on Muslin, 20-yd. rolls .....	.....
No. 862O.	Orange,	20 in. wide,	Tracing Paper, 50-yd. rolls .....	.....
No. 863G.	Green,	20 in. wide,	Drawing Cloth, 20-yd. rolls .....	.....
No. 863O.	Orange,	20 in. wide,	Drawing Cloth, 20-yd. rolls .....	.....
No. 864G.	Green,	20 in. wide,	Tracing Cloth, 20-yd. rolls .....	.....
No. 864O.	Orange,	20 in. wide,	Tracing Cloth, 20-yd. rolls .....	.....

ALCO MILLIMETER PAPERS AND CLOTHS
Continuous in Rolls



Per Roll. Per Yd.

No. 870O.	Orange,	50 cm. wide,	Drawing Paper, 50-yd. rolls.....	.....
No. 871O.	Orange,	50 cm. wide,	Mounted on Muslin, 20-yd. rolls.....	.....
No. 872O.	Orange,	50 cm. wide,	Tracing Paper, 50-yd. rolls.....	.....
No. 874O.	Orange,	50 cm. wide,	Tracing Cloth, 20-yd. rolls.....	.....

STATISTICAL CROSS SECTION PAPER
RULED 10x10 TO ONE INCH

Each 10th horizontal line and each 12th vertical line heavy

Per Roll. Per Yd.

No. 878O.	Orange,	10 in. wide,	Tracing Paper only, 25-yd. rolls.....
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See price list in back of catalog.

ALCO ENGRAVED CROSS SECTION PAPERS IN SHEETS

Size of engraving 16x20 inches.

Illustration of engraving 8x8 to one inch. Quire Sheet

No. 880G.	Green, engraving 8x8 to one inch, on Drawing Paper.....	Quire	Sheet
No. 881O.	Orange, engraving 8x8 to one inch, on Drawing Paper.....		
No. 882O.	Orange, engraving 8x8 to one inch, on Tracing Paper.....		
No. 882G.	Green, engraving 10x10 to one inch, on Drawing Paper.....		
No. 882O.	Orange, engraving 10x10 to one inch, on Drawing Paper.....		
No. 883O.	Orange, engraving 10x10 to one inch, on Tracing Paper.....		
No. 884G.	Green, engraving 12x12 to one inch, on Drawing Paper.....		
No. 885G.	Green, engraving 16x16 to one inch, on Drawing Paper.....		
No. 885O.	Orange, engraving 16x16 to one inch, on Drawing Paper.....		
No. 886O.	Orange, engraving 16x16 to one inch, on Tracing Paper.....		

For ruled Cross Section Papers in Sheets see page 216.

"ALCO" ENGRAVED GRAPHIC PAPERS IN SHEETS

10x10 to the half inch, fifth lines heavy.

		Per 100 Sheets	Quire
No. 890A.	Olive tint, engraving 5 x 7½, on Drawing Paper.....		
No. 891O.	Orange, engraving 5 x 7½, on Tracing Paper.....		
No. 892A.	Olive tint, engraving 7½x10, on Drawing Paper.....		
No. 893O.	Orange, engraving 7½x10, on Tracing Paper.....		
No. 894A.	Olive tint, engraving 10 x15, on Drawing Paper.....		
No. 895O.	Orange, engraving 10 x15, on Tracing Paper.....		

"ALCO" ENGRAVED MILLIMETER PAPERS IN SHEETS

Divided in millimeters, centimeter lines heavy. Per 100
Sheets

		Per 100 Sheets	Quire
No. 900A.	Olive tint, engraving 16x22 cm., on Drawing Paper.....		
No. 901O.	Orange, engraving 16x22 cm., on Tracing Paper.....		
No. 902O.	Orange, engraving 18x25 cm., on Drawing Paper.....		
No. 903O.	Orange, engraving 18x25 cm., on Tracing Paper.....		

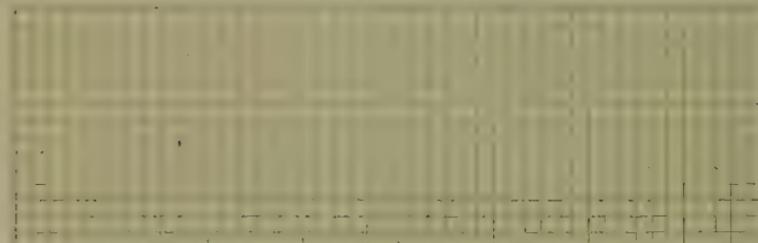
See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

ENGRAVED RECORD SHEETS

	Per 100 Quire Sheet
No. 908. Year by Days Record Paper, 9½x18 inches, on drawing paper green	
No. 909. Year by Days Record Paper, 9½x18 inches, on tracing paper; orange	
No. 910. Year by Days Record Paper, 7x12 inches, on drawing paper; green	
No. 911. Year by Days Record Paper, 7x12 inches, on tracing paper; orange	
No. 912. One Month by Days, 8½x11 inches, on ledger paper; green..	
No. 913. Five Years by Months, 8½x11 inches, on ledger paper; green	
No. 914. Ten Years by Months, 11x17 inches, on ledger paper; green..	

ENGRAVED DATA PAPER



The following are frequently known as Cross Section Papers. Some have the same number of divisions per inch both ways of the sheet, others are divided into different divisions per unit one way from what they are the other. All main division lines are heavier than the subdivision lines. Printed in green on ledger paper.

	Per 100 Sheets
No. 915. Sheet 8½x11 inches, 4 divisions per inch.....	
No. 916. Sheet 8½x11 inches, 5 divisions per inch.....	
No. 917. Sheet 8½x11 inches, 12 divisions per inch.....	
For sheets 6, 8 and 10 divisions per inch see Cross Section and Quadrille Pads listed on page 216.	
No. 919. Sheet 8½x11 inches, 6 by 8 divisions per inch.....	
No. 920. Sheet 8½x11 inches, 12 by 10 divisions per inch.....	
No. 921. Sheet 8½x11 inches, 12 by 20 divisions per inch.....	

See price list in back of catalog.

**SCHOOL CROSS SECTION OR CO-ORDINATE
PAPER****Metric****No. 923**

Ream Quire Sheet

- No. 923.** School Cross Section Paper, metric, 18x24 cm.,
numbered every centimeter on two edges, printed in
green only.....
- No. 924.** Graphic Paper, 8x10 inches, divided 16x16 to
the inch, on Drawing Paper, green.....

POLAR CO-ORDINATE PAPER**No. 924½**

Per 100 Sheets

- No. 924½.** Polar Co-ordinate Paper, sheet 8½x11 inches, on
ledger paper, green.....

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

LOGARITHMIC PAPER

	Per 100	Sheet
No. 925. Engraving 10x10 inches, on Tracing Bond Paper, green only, 5-inch base		
No. 926. Engraving 10x10 inches, on Tracing Bond Paper, green only, 10-inch base		
No. 927A. Engraving 6x9 inches, 12 X logarithmic, 1-cycle 9 in., on ledger paper, green	9	
No. 927B. Engraving 6x9 inches, 12 X logarithmic, 2 cycles 4½ in., on ledger paper, green	12	
No. 927C. Engraving 6x9 inches, 12 X logarithmic, 3 cycles, 3 in., on ledger paper, green	18	
No. 927D. Engraving 7½x10 inches, semi-logarithmic, 20 divisions per inch X 2 cycles 2¾ in., on ledger paper, green	25	

ISOMETRIC SKETCHING PAPER

For Making Drawings and Sketches in Isometric Perspective.



- No. 928C.** Engraving 12x18 in. on drawing paper, green only.

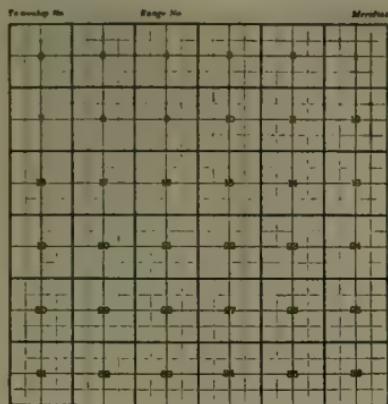
In Pads of 40 Sheets

Per pad

- No. 929A.** Engraving 6x9 inches, on drawing paper, green only....
No. 929B. Engraving 9x12 inches, on drawing paper, green only....

See price list in back of catalog.

TOWNSHIP PAPERS



We offer the following large assortment of Township Papers, printed on the highest grade of ledger or tracing paper, in black or colors, as listed.

ON LEDGER PAPER

	Per pad.
No. 930. Section Plat, $3\frac{1}{2} \times 7\frac{1}{2}$ ", Section $2\frac{3}{4} \times 2\frac{3}{4}$ ". Printed black. In pads of 40 sheets
	Per 100 Each
No. 931. Township Plat, $7 \times 8\frac{1}{2}$ ", $\frac{3}{4}$ -inch Sections. Printed in black, blue and red
No. 933. Township Plat, $8\frac{1}{2} \times 11$ ", 1-inch Sections. In black, blue, red and violet
No. 934. Township Plat, $8\frac{1}{2} \times 11$ ", 1 Township, $\frac{3}{4}$ -inch Sections. Extra section all around township. In black, blue, red and violet....
No. 935. Township Plat, $8\frac{1}{2} \times 11$ ", 1 Township, 1-inch Sections. Extra section all around township. In black, blue, red and violet....
No. 936. School District Plat, $8\frac{1}{2} \times 11$ ", 4 Townships in body, $\frac{1}{2}$ -inch Sections. In black, red and violet.....
No. 937. Township Plat, 14×17 ", with margin for binding, 2-inch Sections. In black, blue, red and violet.....
No. 938. Township Plat, 14×17 ", 20 Townships, $\frac{1}{2}$ -inch Sections. In black, blue and red.....
No. 940. Township Plat, 16×21 ", 12 Townships, $\frac{3}{4}$ -inch Sections. In black, red, violet and green.....
No. 941. Township Plat, 18×21 ", 30 Chains to the inch. In black, blue, red and violet

ON TRACING PAPER

	Per 100	Each
No. 943. Township Plat, 14×17 ", 2-inch Sections. In black only....

PLAT BOOKS

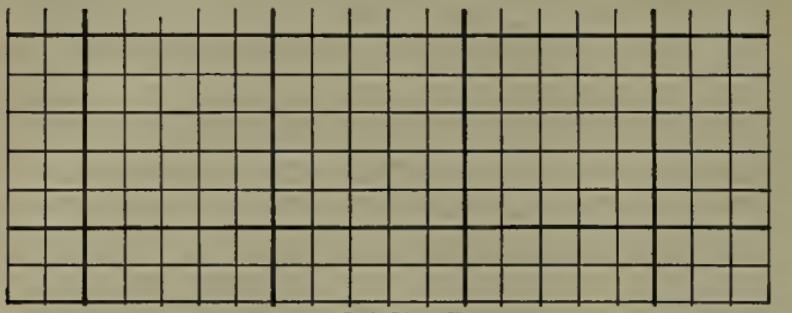
Our Plat Books contain 40 leaves, size $3\frac{3}{4} \times 7$ inches, bound in flexible sheep covers. Printed and ruled in black.

	Doz.	Each
No. 945. Section Plat Book, containing 80 Sections.....
No. 945 $\frac{1}{4}$. Township Plat Book, containing 80 Townships.....
No. 945 $\frac{1}{2}$. Township and Section Plat Book, containing 60 Townships and 60 Sections.....

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

RULED CROSS SECTION PAPER IN SHEETS
On Drawing Paper



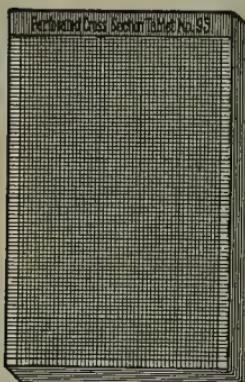
	Inch Lines Heavy	Ream	Quire	Sheet
No. 950.	Sheets 16x21 inches, ruled in blue, 5x5 to one inch.....			
No. 951.	Sheets 16x21 inches, ruled in blue, 8x8 to one inch.....			
No. 952.	Sheets 16x21 inches, ruled in blue, 10x10 to one inch.....			
No. 953.	Sheets 16x21 inches, ruled in blue, 12x12 to one inch.....			

TOPOGRAPHIC PAPER
On Drawing Paper

	Ream	Quire	Sheet
No. 954.	Sheets 16x21 inches, ruled red and blue, 400 feet to 1 inch		

RULED QUADRILLE PAPER IN SHEETS
On Drawing Paper

	All lines equally heavy, inch lines not heavier	Ream	Quire	Sheet
No. 955.	Sheets 16x21 inches, ruled in blue, 4x4 to one inch.....			
No. 956.	Sheets 16x21 inches, ruled in blue, 6x6 to one inch.....			



No. 959

CROSS SECTION PADS

These Cross Section Pads are made of high grade white paper, with perforated top, and contain 60 leaves each.

Inch lines heavy.

Doz. Each

No. 959.	8x10 inches, 10 squares to the inch..
No. 959½.	8x10 inches, 8 squares to the inch..

QUADRILLE PADS

These Quadrille Pads are similar to our Nos. 959-959½ pads, but are ruled 4 squares to the inch, all lines equally heavy.

No. 963. 8x10 inches

Nos. 964-966 Quadrille Pads are made of high grade white paper, with gummed side and top, and contain 60 leaves each. All lines ruled equally heavy.

Doz. Each

No. 964. 8½x11 inches, ruled 10 squares to the inch.....

No. 965. 8½x11 inches, ruled 8 squares to the inch.....

No. 966. 8½x11 inches, ruled 6 squares to the inch.....

Nos. 967-969 Quadrille Pads are made of good grade Chemical Manila paper, with gummed side and top, and contain 60 leaves each. All lines ruled equally heavy.

Doz. Each

No. 967. 8½x11 inches, ruled 10 squares to the inch.....

No. 968. 8½x11 inches, ruled 8 squares to the inch.....

No. 969. 8½x11 inches, ruled 6 squares to the inch.....

See price list in back of catalog.

FIGURING PADS



Nos. 970-974



Nos. 975-979

Nos. 970-974 Figuring Pads are made of good quality white paper, adapted for pen or pencil use. Tops of leaves perforated for removal. 72 leaves to pad.

Doz. Each

No. 970.	4 x 6 inches	.....
No. 971.	4½ x 7 inches	.....
No. 972.	5 x 8 inches	.....
No. 973.	6 x 9 inches	.....
No. 974.	7 x 12 inches	.....

Nos. 975-978 Figuring Pads are made of high grade Canary writing paper adapted for pen or pencil use. Tops of leaves perforated for removal. 72 leaves to pad.

Doz. Each

No. 975.	4 x 6 inches	.....
No. 976.	4½ x 7 inches	.....
No. 977.	5 x 8 inches	.....
No. 978.	6 x 9 inches	.....
No. 979.	8 x 12 inches	.....

LEGAL TABLETS

These Commercial Tablets are made of good grade Manila writing paper ruled on both sides. 50 leaves to tablet.

Doz. Each

No. 980.	8x12½ with margin.
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LOG SCALE SHEETS

LENGTH IN FEET	DIAMETER IN INCHES												60 LEAVES TO FT.						
	32	33	34	35	36	37	38	39	40	41	42	43							
16	161	188	748	796	845	897	950	1006	1064	1124	1185	1248	1312	1377	1448	1513	2704	16	
18	181	21	9	841	895	951	1009	1069	1132	1197	1264	1333	1404	1476	1549	1625	1700	3042	18
20	201	23	6	935	995	1050	1121	1188	1258	1330	1405	1481	1560	1640	1721	1810	1866	3380	20
22	221	258	4	1028	1094	1162	1233	1307	1384	1463	1545	1620	1716	1804	1893	1991	2222	3718	22
24	242	282	1122	1194	1268	1346	1426	1510	1596	1686	1778	1872	1968	2066	2172	2280	4056	24	
26	262	304	1214	1292	1372	1458	1544	1634	1728	1826	1926	2028	2132	2238	2347	246	4394	26	
28	282	328	1308	1392	1478	1570	1662	1760	1862	1960	2074	2184	2296	2410	2525	2672	4732	28	
30	302	34	1402	1492	1584	1682	1782	1886	1994	2106	2222	2340	2460	2582	2714	2800	5070	30	
32	322	376	12	1496	1592	1690	1794	1900	2012	2128	2248	2370	2496	2624	2754	2896	326	5408	32

Doz. Each

No. 982. Columbia River Log Scale Sheets, 17x28 inches....

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

DRAWING PAPERS

We deem it unnecessary to make much comment on an article so universally used. The draftsman has learned of its qualities from his earliest experiences, so we only desire to assure our friends that the papers we carry represent the standards of excellence for the respective purposes for which they are intended.

DRAWING PAPERS IN SHEETS



Whatman's Drawing Papers, "Selected Best" and "Retree," are made as one quality and the sheets are afterwards examined and separated at the mill. The "Selected Best" are sheets without imperfections. Made in three different surfaces. When ordering please state size and surface desired.

No. 1000. WHATMAN'S Hand-Made Drawing Paper, with H. P. (smooth surface), C. P. (finely grained surface) or R. (rough surface).*

	Ream	Selected Quire	Best Sheet	Ream	Retree Quire	Sheet
Cap	13x17 inches					
Demy	15x20 inches					
Medium	17x22 inches					
*Royal	19x24 inches					
*Imperial	22x30 inches					
Atlas	26x34 inches					
*Double Elephant...	27x40 inches					
Antiquarian	31x53 inches					

*These sizes ONLY are carried in R. (rough surface).

No. 1001. WHATMAN'S Extra Heavy Hand-Made Drawing Paper, with H. P., C. P. or R. surface. Selected Best only.

	Ream	Quire	Sheet
Imperial	22x30 inches (140-lb. stock)		
Double Elephant...	27x40 inches (260-lb. stock)		

Mounted Whatman Hand-Made Drawing Papers, see page 230.
Complete sample book of Whatman's Papers sent on application.

See price list in back of catalog.

WHITE DRAWING PAPERS IN SHEETS



No. 1005. "ORLAND" Drawing Paper. A pure white drawing paper of highest quality. Very tough, with smooth hard surface. Will stand erasing perfectly. An excellent paper for ink line drawings. All sizes are of the same thickness.

Size—Inches	Ream	Quire	Sheet
18x24			
22x30			
27x40			

No. 1006. "SEQUOIA" Drawing Paper. A pure white drawing paper of very high quality. Medium surface. Adapted for pencil, ink or color work, and will stand erasing perfectly. An excellent paper for school or college work. All sizes are of the same thickness.

Size—Inches	Ream	Quire	Sheet
9x12			
12x18			
18x24			
22x30			
24x36			
27x40			

No. 1007. "PACIFIC" Drawing Paper. A white drawing paper of good quality. Slightly grained surface, adapted for pencil, ink, crayon or color work. Very suitable for use in schools, etc. The various sizes differ in thickness, the Double Elephant being the heaviest and the Cap the lightest.

Size—Inches	Ream	Quire	Sheet
13½x17			
15 x20			
17 x22			
19 x24			
22 x30			
27 x40			

Samples of any of our papers sent on application.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

**CREAM DRAWING AND DETAIL PAPERS IN
SHEETS**



No. 1008. "MODOC" Drawing Paper. A cream color drawing paper of superior quality. It is tough, hard, uniform in grain and finish, stands erasing perfectly, and is an excellent paper for pencil, ink or color work. Will stand handling without soiling. All sizes are of the same thickness.

Size—Inches	Ream	Quire	Sheet
9x12			
12x18			
18x24			
22x30			
24x36			
27x40			

"Modoc" Drawing Paper in rolls, see Catalog No. 1080.

No. 1009. "MOHAVE" Drawing Paper. A cream color drawing paper of very good quality. It is strong, uniform in grain and finish, stands erasing, and takes ink and color well. An excellent paper for schools and general drawing. All sizes are of the same thickness.

Size—Inches	Ream	Quire	Sheet
9x12			
12x18			
18x24			
22x30			
24x36			
27x40			

"Mohave" Drawing Paper in rolls, see Catalog No. 1081.

No. 1010. "EL SINORE" Detail Paper. A tough paper of grained surface, a trifle darker in shade than the cream papers, possessing good erasing qualities. Suitable for either ink or pencil. All sizes are of the same thickness.

Size—Inches	Ream	Quire	Sheet
9x12			
12x18			
18x24			
24x36			

"Elsinore" Detail Paper in rolls, see Catalog No. 1086B.

Samples of any of our papers sent on application.

See price list in back of catalog.

WATER COLOR BOARDS

- No. 1015.** Whatman's Water Color Board. Whatman Paper mounted on heavy board for water color work, with H. P. (smooth surface), C. P. (finely grained surface) or R. (rough surface). When ordering, please state surface desired. Per dozen Each
22x30 inches

MOUNTING, POSTER AND MAT BOARDS

- No. 1016.** Strathmore Illustrating Board. A superior quality water color paper, with medium surface, mounted on heavy board. Per dozen Each
30x40 inches

- No. 1017.** Plain Chip Board, especially adapted for mounting purposes. Size of board 30x40.....

- No. 1018.** Cream and White Mounting Board. Cream on one side and white on the other. For mounting and matting. Size of sheet 28x44.....
Thick
Double thick

- No. 1020.** Alco Colored Showcard Board. Smooth dull surface in various colors. Size of sheet 28x44.....

CLASS A—Artists' white sheet.

CLASS B—Forest green ripple.
Iris green ripple.
Sky blue ripple.

CLASS C—Autumn brown, chocolate, jet black, Scotch grey, ash grey, India tint cream.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

ARTISTS' PAPERS AND BOARDS
STRATHMORE DRAWING BOARDS



A superior quality Bristol Board, made in two finishes, S. (smooth or high surface) for Pen and Ink Drawing, and M. (medium, or dull surface) for Pencil, Pen and Water Color work, in 2, 3, 4, and 5 sheet thicknesses.

When ordering please state size, surface and thickness desired.

No. 1025. Strathmore Drawing Boards, with S. (smooth or high surface) or M. (medium or dull surface).

Size—	23x29 in.	Each	Each
2 Sheet*		4 Sheet	
3 Sheet		5 Sheet	

2- and 3-sheet Strathmore Drawing Boards are put up in packages of 50 sheets; 4- and 5-sheet, in packages of 25 sheets. Special prices for quantities.

CHARCOAL PAPERS

No. 1028. Strathmore Charcoal Paper.

White only. Per Ream Quire Sheet
Royal, 19x24 inches.....

ADHESIVE PAPER AND CLOTH TAPE
For the binding of drawings to prevent tearing.



Nos. 1043-44



Nos. 1046-47

Per doz. Per spool

No. 1043. Adhesive Transparent Paper Tape, in handy roll metal container; 1000 inches $\frac{1}{2}$ inch wide.....

No. 1044. Adhesive Transparent Paper Tape, in handy roll metal container; 800 inches, $\frac{1}{8}$ -inch wide.....

No. 1045. Adhesive Transparent Paper Tape, in rolls of 12 yards, $\frac{5}{8}$ -inch wide

No. 1046. White Gummed Cloth Tape, in rolls of 10 yards, $\frac{3}{4}$ -inch wide

No. 1047. Same as No. 1046, but $1\frac{1}{4}$ inches wide.....

No. 1048. Transparent, Gummed Cloth Tape, in rolls of 10 yards, $\frac{3}{4}$ -inch wide

See price list in back of catalog.

MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS THE A. LIETZ COMPANY
SAN FRANCISCO, U. S. A.

BRISTOL BOARDS

No. 1052. "ALCO" DOMESTIC BRISTOL BOARD.

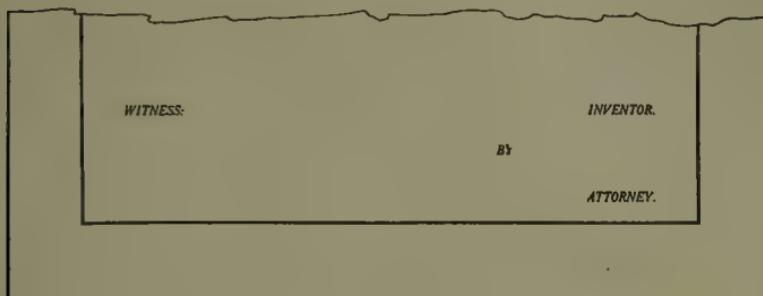
Per Dozen Each

3 Sheet*, size 22x28 inches.....

No. 1054. REYNOLDS' BRISTOL BOARDS.

Size—	2 Sheets* Dozen Sheet	3 Sheets* Dozen Sheet	4 Sheets* Dozen Sheet
12 x15 inches.....			
14 x18 inches.....			
16½x21 inches.....			
17 x22 inches.....			
20½x28 inches.....			

PATENT OFFICE BRISTOL BOARDS



Patent Office Bristol Board, Printed (With border, etc.)

		Gross	Dozen	Each
No. 1055A.	Reynolds' 2-sheet, 10x15 inches, U. S. Standard			
No. 1055B.	Reynolds' 3-sheet, 10x15 inches, U. S. Standard			
No. 1056 ½ A.	Strathmore 2-sheet, 10x15 inches, U. S. Standard			
No. 1056 ½ B.	Strathmore 3-sheet, 10x15 inches, U. S. Standard			

Patent Office Bristol Board, Plain (Not printed)

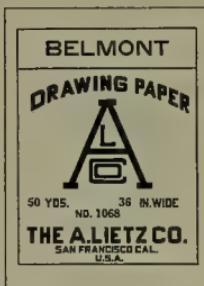
		Gross	Dozen	Each
No. 1057A.	Reynolds' 2-sheet, 10x15 inches, U. S. Standard			
No. 1057B.	Reynolds' 3-sheet, 10x15 inches, U. S. Standard			
No. 1058 ½ A.	Strathmore 2-sheet, 10x15 inches, U. S. Standard			
No. 1058 ½ B.	Strathmore 3-sheet, 10x15 inches, U. S. Standard			

*NOTE—The term "Sheet," as used above, designates the thickness of the various Drawing or Bristol Boards, being the number of sheets pasted together in order to obtain the stated thickness. Also sometimes referred to as "Ply."

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

WHITE DRAWING PAPERS IN ROLLS



No. 1060. "LASSEN" Drawing Paper, Medium. A pure white drawing paper of highest quality. Very tough with a hard, slightly **grained** surface, will stand erasing perfectly. An excellent paper for all kinds of finished drawings, for pen, ink and water color, for outdoor work or for use in shops, where drawings are subject to much handling.

	Per roll of 25 yds.	10 yds.	Per yd.
36 inches wide			
42 inches wide			
63 inches wide			
In original rolls of about 40 pounds, any width; per pound.....			

No. 1061. "LASSEN" Drawing Paper, Heavy. Same as No. 1060 but heavier.

	Per roll of 25 yds.	10 yds.	Per yd.
63 inches wide			
72 inches wide			
In original rolls of about 40 pounds, any width; per pound.....			

No. 1064. "RAMONA" Drawing Paper, Medium. A high-grade white drawing paper, with **Eggshell** surface. For all kinds of finished drawings, for pen, ink, water color or airbrush work.

	Per roll of 25 yds.	10 yds.	Per yd.
36 inches wide			
42 inches wide			
63 inches wide.....			
In original rolls of about 40 pounds, any width; per pound.....			

No. 1065. "RAMONA" Drawing Paper, Heavy. Same as No. 1064 but heavier.

	Per roll of 25 yds.	10 yds.	Per yd.
63 inches wide			
In original rolls of about 40 pounds; per pound			

See price list in back of catalog.

MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS THE A. LIETZ COMPANY
SAN FRANCISCO, U. S. A.

WHITE DRAWING PAPERS IN ROLLS

No. 1068. "BELMONT" Drawing Paper, Medium. A pure white drawing paper of superior quality. Very tough and strong, smooth surface. Can be folded without breaking. Especially adapted for mapping and general working drawings subject to rough handling.

Per roll of
25 yds. 10 yds. Per yd.

36 inches wide

63 inches wide

In original rolls of about 40 pounds; per pound.....

No. 1069. "BELMONT" Drawing Paper, Heavy. Same as No. 1068 but heavier.

Per roll of
25 yds. 10 yds. Per yd.

63 inches wide

In original rolls of about 40 pounds; per pound.....

No. 1070. "AVENA" Drawing Paper. A pure white drawing paper with excellent erasing qualities. The surface is slightly grained, making it desirable for ink, pencil or water color work.

Per roll of
50 yds. 10 yds. Per yd.

30 inches wide

36 inches wide

42 inches wide

60 inches wide

In original rolls of about 40 pounds, any width; per pound.....

No. 1071. "VENTURA" Drawing Paper. A moderate priced white drawing paper with good erasing qualities. Slightly grained surface, suitable for pencil and ink work.

Per roll of
50 yds. 10 yds. Per yd.

36 inches wide

42 inches wide

In original rolls of about 40 pounds, any width; per pound.....

No. 1073. "TEHAMA" Drawing Paper. A white bond paper, unglazed, for pencil or ink drawing. Very strong.

Per roll of
50 yds. 10 yds. Per yd.

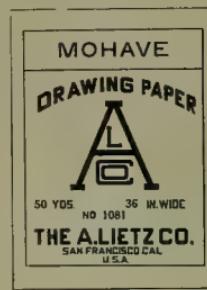
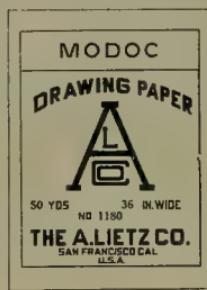
42 inches wide

Samples of any of our papers will be mailed upon application.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

DRAWING AND DETAIL PAPERS IN ROLLS



CREAM DRAWING PAPER

No. 1080. "MODOC" Drawing Paper. The highest grade cream color Drawing and Detail Paper. The surface is hard, slightly grained, and takes pencil, ink or water color. The erasing qualities are excellent. The cream or buff color is pleasing to the eye and permits much handling without soiling.

No. 1008. Is the same paper in sheets.

	Per roll of 50 yds.	10 yds.	Per yd.
30 inches wide			
36 inches wide			
42 inches wide			
63 inches wide			
In original rolls of about 40 pounds, any width; per pound.....			

No. 1081. "MOHAVE" Drawing Paper. A cream color drawing and detail paper with good erasing qualities. It is strong, of uniform grain and finish, and is an excellent paper for schools and all general drawing. Will take ink and water color.

No. 1009. Is the same paper in sheets.

	Per roll of 50 yds.	10 yds.	Per yd.
30 inches wide			
36 inches wide			
42 inches wide			
In original rolls of about 40 pounds, any width; per pound.....			

GREEN DRAWING PAPER

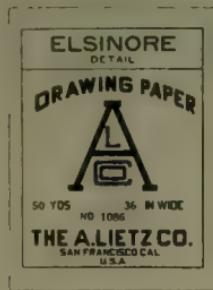
No. 1084. "ENCINAL" Drawing Paper. A light green drawing paper similar in texture and surface to our No. 1080 Modoc Drawing Paper. Its color is resting to the eye and permits much handling without soiling.

	Per roll of 50 yds.	10 yds.	Per yd.
36 inches wide			
42 inches wide			
In original rolls of about 40 pounds, per pound.....			

See price list in back of catalog.

MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS THE A. LIETZ COMPANY
SAN FRANCISCO, U. S. A.

DETAIL PAPERS IN ROLLS



BUFF COLOR DETAIL PAPERS

No. 1086A. "EL SINORE" Detail Paper, Thin. A buff color detail paper, of a darker shade than our cream drawing papers, made of selected rag stock. It has a slightly grained surface, will take ink or pencil and erases well. Will stand rough handling and lies perfectly flat on drawing board.

Per roll of
100 yds. 50 yds. 10 yds. Per yd.

36 inches wide

42 inches wide

In original rolls of about 100 to 150 pounds, per pound.....

No. 1086B. "EL SINORE" Detail Paper, Medium. Same as No. 1086A but of medium heavy weight.

No. 1010. Is the same paper in sheets.

Per roll of
100 yds. 50 yds. 10 yds. Per yd.

36 inches wide

42 inches wide

48 inches wide

54 inches wide

In original rolls of about 100 to 150 pounds, per pound.....

No. 1086C. "EL SINORE" Detail Paper, Heavy. Same as No. 1086A but extra heavy.

Per roll of
100 yds. 50 yds. 10 yds. Per yd.

36 inches wide

42 inches wide

48 inches wide

54 inches wide

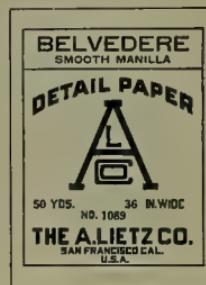
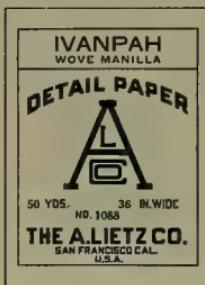
In original rolls of about 100 to 150 pounds, per pound.....

Samples of any of our papers will be mailed on application.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

MANILA DETAIL PAPERS IN ROLLS



No. 1087. "ALCATRAZ" Laid Manila Detail Paper, medium, slightly ribbed surface. Suitable for drafting purposes and will stand reasonable amount of erasing.

Per roll of 100 yds. 50 yds. 10 yds. Per yd.

36 inches wide
42 inches wide
48 inches wide

In original rolls of about 60 pounds, any width, per pound.....

No. 1088. "IVANPAH" Wove Manila Detail Paper, medium, slightly grained surface. Can be used for drafting and will stand reasonable amount of erasing.

Per roll of 100 yds. 50 yds. 10 yds. Per yd.

36 inches wide
42 inches wide
48 inches wide

In original rolls of about 60 pounds, any width, per pound.....

No. 1089. "BELVEDERE," Smooth Manila Detail Paper, smooth surface. Used for stencils, etc., also for covering drawing boards in drafting rooms.

50 yds. 10 yds. Per yd.

42 inches wide
36 inches wide

In original rolls of about 100 pounds, any width, per pound.....

PAPER CLOTH

No. 1095. "PORTOLA," Paper Cloth, a thin, white, strong and practically indestructible cloth, made expressly for drafting purposes. Takes ink and pencil well and erases perfectly. Admits of blue printing or negative making.

10 yds. Per yd.

36 inches wide
42 inches wide

Samples of any of our papers or cloths will be mailed upon application.

See price list in back of catalog.

KNIVES FOR CUTTING PAPER AND CLOTH

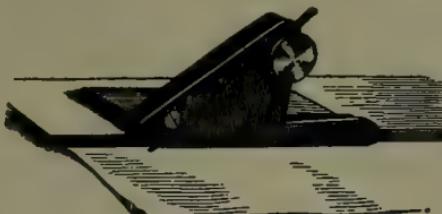


No. 1096

Each

No. 1096. Cutting Knife with adjustable blade.....

No. 1096A. Extra Blades for No. 1096 cutting knife.....



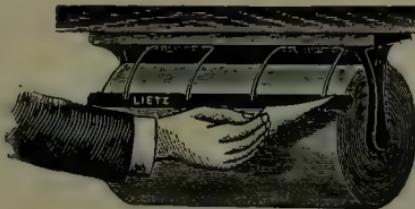
No. 1098

Each

No. 1098. Handy Paper Cutter, nickel plated.....

These tools are used for cutting drawings from the board, also for cutting any kind of paper or bristol board. They can be slid along T-square or straight-edge without injuring its edge, and have a thumbscrew adjustment which may be set so as to cut only the thickness of the paper, without marking the drawing board.

HANGING PAPER BRACKETS AND CUTTERS



No. 1099

No. 1099. Hanging Paper Bracket and Cutter.

Size, inches .....	.....	12	18	24	30	36
Each .....	.....	.....	.....	.....	.....	.....

For Paper Trimmers see page 249.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

MOUNTED DRAWING PAPERS IN SHEETS

These Papers are mounted on the best quality muslin to give strength so that they will not tear or break. Specially adapted for maps and valuable drawings and for plat books, etc.



PAPERS MOUNTED ONE SIDE ONLY

No. 1000MS. **WHATMAN'S** Selected Best Hand-Made Drawing Paper, **Mounted**, with H. P. (smooth surface) or C. P. (finely grained surface). When ordering, please state size and surface desired.

Per Quire Per Sheet

Royal, 19x24 inches	
Imperial, 22x30 inches	
Double Elephant, 27x40 inches	

No. 1060MS. "LASSEN" Drawing Paper, **Mounted**. Same paper as our No. 1060.

Per Quire Per Sheet

Royal, 19x24 inches	
Imperial, 22x30 inches	
Double Elephant, 27x40 inches	

No. 1064MS. "RAMONA" Drawing Paper, **Mounted**. Same paper as our No. 1064.

Per Quire Per Sheet

Royal, 19x24 inches	
Imperial, 22x30 inches	
Double Elephant, 27x40 inches	

DOUBLE-MOUNTED DRAWING PAPERS

Double-Mounted Papers are especially adapted for Atlas or Map work, having muslin in the middle with paper on both sides.

No. 1000DMS. 'WHATMAN'S Selected Best Hand-Made Drawing Paper, **Double Mounted**, with H. P. (smooth surface) or C. P. (slightly grained surface).

When ordering please state size and surface desired.

Per Quire Per Sheet

Royal, 19x24 inches	
Imperial, 22x30 inches	
Double Elephant, 27x40 inches	

No. 1060DMS. "LASSEN" Drawing Paper, **Double Mounted**. Same paper as our No. 1060.

Per Quire Per Sheet

Imperial, 22x30 inches	
Double Elephant, 27x40 inches	

No. 1064DMS. "RAMONA" Drawing Paper, **Double Mounted**. Same paper as our No. 1064.

Per Quire Per Sheet

Imperial, 22x30 inches	
Double Elephant, 27x40 inches	

We have a well equipped plant for mounting maps, blue prints, and are prepared to do mounting of any nature. All work guaranteed and orders promptly and accurately executed. Write for estimates.

See price list in back of catalog.

MOUNTED DRAWING PAPERS IN ROLLS

Mounted one side only on the best quality muslin to give strength so that they will not tear or break.

No. 1060M. "LASSEN" Drawing Paper, Mounted. Same paper as our No. 1060.

Per roll of
10 yds. Per yd.

36 inches wide
42 inches wide
63 inches wide

No. 1061M. "LASSEN" Drawing Paper, Heavy, Mounted. Same paper as our No. 1061.

Per roll of
10 yds. Per yd.

63 inches wide
72 inches wide

No. 1064M. "RAMONA" Drawing Paper (Eggshell), Mounted. Same paper as our No. 1064.

Per roll of
10 yds. Per yd.

36 inches wide
42 inches wide
63 inches wide

No. 1065M. "RAMONA" Drawing Paper, Heavy (Eggshell), Mounted. Same paper as our No. 1065.

Per roll of
10 yds. Per yd.

63 inches wide
72 inches wide

No. 1068M. "BELMONT" Drawing Paper, Mounted. Same paper as our No. 1068.

Per roll of
10 yds. Per yd.

36 inches wide
63 inches wide

No. 1069M. "BELMONT" Drawing Paper, Heavy, Mounted. Same paper as our No. 1069.

Per roll of
10 yds. Per yd.

63 inches wide
72 inches wide

No. 1070M. "AVENA" Drawing Paper, Mounted. Same paper as our No. 1070.

Per roll of
10 yds. Per yd.

30 inches wide
36 inches wide
42 inches wide
60 inches wide

No. 1080M. "MODOC" Cream Drawing Paper, Mounted. Same paper as our No. 1080.

Per roll of
10 yds. Per yd.

30 inches wide
36 inches wide
42 inches wide
63 inches wide

Complete sample book of drawing papers mailed on request.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

TRACING CLOTHS IN ROLLS



GREAT BRITAIN



GREAT BRITAIN

No. 1100. "EXCELSIOR" Tracing Cloth. Extra transparent. Glazed on one side and dull on the other.

Per roll of
24 yds. Per yd.

30 inches wide
36 inches wide
42 inches wide

No. 1101. "IMPERIAL" Tracing Cloth. Glazed on one side and dull on the other.

Per roll of
24 yds. Per yd.

24 inches wide
30 inches wide
36 inches wide
38 inches wide
41 inches wide
48 inches wide
54 inches wide

No. 1102. "ALCO" Tracing Cloth. A high-grade product equal to the best imported cloths. Glazed on one side and dull on the other.

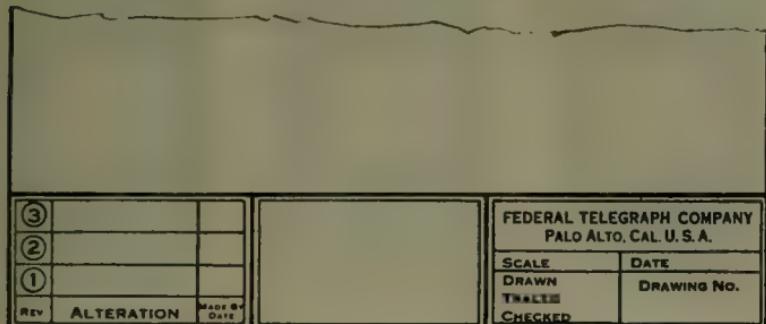
Per roll of
24 yds. Per yd.

30 inches wide
36 inches wide
42 inches wide

See price list in back of catalog.

TRACING CLOTHS IN SHEETS

Printed with borders and titles



The constantly increasing demand of the larger drawing rooms for standard sizes of tracing cloth and tracing paper sheets has induced us to cater to this requirement. We have executed any number of intricate jobs and our experiences are offered the profession with the assurance that highly satisfactory results will be had if this work is entrusted to us. Special non-smearing and absolutely opaque ink used.

We call attention to the illustration above. Note that the printed headings are absolutely in line with the horizontal rulings, also that the lines are unbroken and joined perfectly, an accomplishment unattainable unless executed in our special manner. Sheets printed on the under or reverse side, if desired, to allow for thorough erasing or cleaning without danger of destroying the printed matter.

Considering the time required for ruling borders and inserting corner titles and the saving of material, printed sheets are both efficient and economical. Let us quote you, regardless of size, quantity or intricacy of composition.

TRACING CLOTH REQUISITES



1106



1107

No. 1106. Pounce, or Tracing Cloth Powder, in shaker can. Each.....

No. 1106 should be used for removing gloss from Tracing Cloth, which often prevents inks and water colors from adhering properly.

No. 1107. Inkwash. A superior article for removing waterproof ink from Tracing Cloth. In bottles of 1 pint 4 oz. 1 oz.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

TRACING PAPERS IN ROLLS



No. 1120. "VELLUM" Tracing Paper. An exceptionally strong tracing paper. Very transparent. Excellent for ink and water color work. Will not buckle nor become brittle with age. Put up in pasteboard tubes with metal ends.

Per roll of 20 yds. Per yard

30 inches wide
36 inches wide
42 inches wide

No. 1121. "ALTURAS" Tracing Paper. A dull finish water-proof tracing paper of exceptional strength and transparency. Bluish tint. Excellent for ink or water color work.

Per roll of 20 yds. Per yard

36 inches wide
42 inches wide

No. 1125. "YUBA" Tracing Paper. Smooth surface. Very transparent. Excellent for tracing from blue prints. Will take ink or pencil.

Per roll of 20 yds. Per yard

42 inches wide

No. 1126. "SIERRA" Tracing Paper, thin. A very transparent white paper, especially adapted for tracing from blue prints. Takes ink and pencil, and is very strong and durable.

Per roll of 20 yds. Per yard

42 inches wide

No. 1127. "SIERRA" Tracing Paper, medium. Same as No. 1126, but heavier.

Per roll of 20 yds. Per yard

42 inches wide

No. 1129. "SHASTA" Tracing Paper, thin. A white paper slightly glazed, very transparent, smooth surface. Very strong. For ink and pencil work.

Per roll of 20 yds. Per yard

42 inches wide

See price list in back of catalog.

SKETCHING AND DETAIL TRACING PAPERS IN ROLLS

No. 1130. "DOLORES" Tracing Paper. A thin, white, natural tracing paper, adapted for pen and ink perspectives. Very strong.

Per roll of 44 yds. Per yd.

42 inches wide

57 inches wide.....

No. 1132. "EXPOSITION" Tracing Paper. A thin, strong paper for tracing full size details, adapted to pencil only.

50 yds. Per yd.

36 inches wide

42 inches wide

48 inches wide

No. 1134. "VERNALIA" Tracing Paper. An unglazed, white tracing paper of good strength and transparency.

Per roll of 20 yds. Per yd

42 inches wide

No. 1135. "SUTTER" Tracing Paper. A white, natural tracing paper of great strength and transparency. With surface for pencil work.

Per roll of 44 yds. Per yd

42 inches wide

57 inches wide

No. 1137. "SONORA" Tracing and Sketching Paper, Medium. A white paper, strong and tough, especially made for sketching and transferring. Stands erasing and takes pencil, ink and color well.

Per roll of 50 yds. Per yd.

36 inches wide

42 inches wide

62 inches wide

No. 1139. "MADERA" Tracing and Sketching Paper, Medium. A white paper, will take ink and color perfectly. Can be used for tracing, adaptable for blueprinting.

Per roll of 50 yds. Per yd.

36 inches wide

42 inches wide

60 inches wide

No. 1140. "MADERA" Tracing and Sketching Paper, Heavy. Like No. 1139, but considerably heavier, used for sketching only.

Per roll of 50 yds. Per yd.

42 inches wide

No. 1145. "YOSEMITE" Tracing Paper, Extra Thin. Glazed, often referred to as glass paper. For use of the lithographer, etc.

Per roll of 20 yds. Per yd.

42 inches wide

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

SKETCH BLOCKS



No. 1155. SKETCH BOOKS, stiff canvas covered, containing 24 leaves of good quality white drawing paper with slightly grained surface.

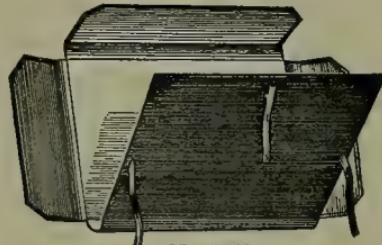
Inches— 4x7 6x9 10x14
Each



No. 1158. "PACIFIC" Sketch Blocks. Made of No. 1007 "Pacific" White Drawing Paper. 20 sheets to pad.

Inches— 5x7 7x10 10x14 14x20
Dozen
Each

PORTFOLIOS



No. 1160

No. 1160. PORTFOLIOS, cloth sides, leather back and corners, with three flaps.

Inches— 12x16 14x20 17x22 20x26 23x31
Each

No. 1161. PORTFOLIOS, paper sides, cloth back and corners, with three flaps.

Inches— 12x16 14x20 17x22 20x26 23x31
Each

See price list in back of catalog.

BLUE PRINT PAPERS

We use only the purest chemicals and guarantee every yard.

Your attention is directed to the various printing speeds with which we prepare our papers. When ordering kindly state which of the following three solutions is desired:

"REGULAR" (R), for sun printing or blue line work.

"RAPID" (XR), for fast printing in daylight.

"ELECTRIC RAPID" (XXR), for electric printing or for use on dark days.



No. 1180. "APOLLO" Blue Print Paper, Medium Thick. A good strong paper, in the bath and out, for general printing. Rich blue tone, will wash pure white.

Inches wide—	30	36	42
--------------	----	----	----

Per roll of 10 yards.....			
---------------------------	--	--	--

Per roll of 50 yards.....			
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No. 1181. "STEORRA" Blue Print Paper, Thin. This paper is especially adapted for mailing purposes.

Inches wide—	30	36	42
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Per roll of 10 yards.....			
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Per roll of 50 yards.....			
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No. 1182. "VELVET" Blue Print Paper, Medium Thick. A first-class paper. Will withstand much handling, and serve well as records.

Inches wide—	30	36	42
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Per roll of 10 yards.....			
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Per roll of 50 yards.....			
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No. 1183. "ALCO" Blue Print Paper, Medium Thick. Finest quality, especially well adapted for blue line work.

Inches wide—	30	36	42	54
--------------	----	----	----	----

Per roll of 10 yards.....				
---------------------------	--	--	--	--

Per roll of 50 yards.....				
---------------------------	--	--	--	--

Samples of any of our papers will be mailed upon application.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

BLUE PRINT PAPERS

When ordering kindly state which solution is wanted. See heading page 237.

No. 1184. "PARCHMENT" Blue Print Paper, Thin. The best and strongest paper made, very tough and durable. Will stand much handling and is ideal for permanent record filing.

Inches wide—	24	30	36	42	54
Per roll of 10 yards.....					
Per roll of 50 yards.....					

No. 1185. "PARCHMENT" Blue Print Paper, Medium Thick. Same quality as No. 1184, but heavier.

Inches wide—	30	36	42	42
Per roll of 10 yards.....				
Per roll of 50 yards.....				

No. 1186. "WAWONA" Special Blue Line Paper, Medium Thick.

Inches wide—	30	36	42	54
Per roll of 10 yards.....				
Per roll of 50 yards.....				

ALCO BLUE PRINT CLOTHS

No. 1190. "ALCO" Blue Print Cloth, Medium.

Inches wide—	30	36	42	54
Per roll of 10 yards.....				
Per roll of 50 yards.....				

No. 1191. "ALCO" Blue Print Cloth, Thin.

Inches wide—	30	36	42
Per roll of 10 yards.....			
Per roll of 50 yards.....			
In ordering kindly state which solution is wanted.			

ALCO BLUE PRINT INTENSIFIER

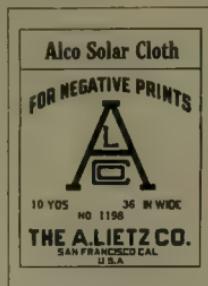
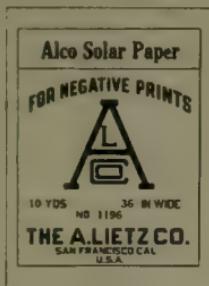
For developing overexposed prints and treatment of blue line prints to intensify the blue and to clarify the white background. In crystal form.

No. 1193. Alco Blue Print Intensifier. Per pound.....

See price list in back of catalog.

SOLAR PAPERS AND CLOTHS**For Negative and Positive Printing**

Sufficient developing salt furnished with each roll.

**No. 1195. "ALCO" Solar Paper, Medium Thick.** For positive prints.

Inches wide—	30	36	42	54
Per roll of 10 yards.....				
Per roll of 50 yards.....				

No. 1196. "ALCO" Solar Paper, Thin. For Negative Prints.

Inches wide—	30	36	42	54
Per roll of 10 yards.....				
Per roll of 50 yards.....				

No. 1197. "ALCO" Solar Cloth, Medium Thick. For Positive Prints.

Inches wide—	30	36	42	54
Per roll of 10 yards.....				

No. 1198. "ALCO" Solar Cloth, Thin. For Negative Prints.

Inches wide—	30	36	42	54
Per roll of 10 yards.....				

ALCO FIXING SALT

For intensifying and fixing prints.

No. 1200. 2-ounce can**No. 1202.** 1-pound can**ALCO TRANSPARENTIZING FLUID**

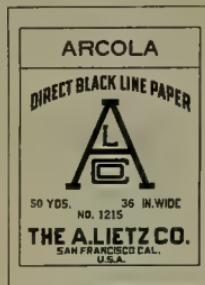
For treating negatives to allow faster printing, or making regular drawings transparent for printing.

No. 1205. 1-quart can**No. 1207.** 1-gallon can

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND SURVEYORS' INSTRUMENTS

DIRECT PROCESS PAPERS AND CLOTHS



No. 1215. "ARCOLA" Direct Black Line Paper, Medium Thick. Is washed exactly like blue print paper, requires but one water bath, no chemical bath necessary. Will print sharp, clear black lines on a white background. Will keep fresh for several months and will not become brittle with age.

Inches wide—	30	36	42
Per roll of 10 yards.....			
No. 1216. "ARCOLA" Direct Black Line Paper, Thin.			
Inches wide—	30	36	42
Per roll of 10 yards.....			
No. 1217. "COLOMA" Direct Black Line Cloth.			
Inches wide—	30	40	
Per roll of 10 yards.....			

ALCO ERASING FLUIDS



For making alterations on Blue Prints or Negatives.

No. 1220.	White, for Blue Prints; per bottle.....
No. 1221.	Red, for Blue Prints; per bottle.....
No. 1222.	Yellow, for Blue Prints; per bottle.....
No. 1223.	White, for Negative Prints; per bottle.....

White Pencils for marking blue prints listed on page 457.

OPAQUES

For correcting mistakes and faults in negatives.

No. 1225.	Liquid Opaque; per 1-ounce bottle.....
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See price list in back of catalog.

UNPREPARED BLUE PRINT PAPER AND CLOTHS

While these papers and cloths are primarily intended to be coated with a chemical solution for blue-printing purposes, etc., they are admirably adapted for use as drawing papers or cloths. Each paper is a specially selected stock, the best in its particular class. We especially recommend our Nos. 1184U and 1185U "Parchment" Papers, which are excellent for pencil, ink or water color work. Nos. 1190U and 1191U "Alco Cloths" will also take ink or water color.

No. 1180U. "APOLLO," medium thick, unprepared.				
Inches wide—	30	36	42	
Per 50-yard roll.....				
No. 1181U. "STEORRA," thin, unprepared.				
Inches wide—	30	36	42	
Per 50-yard roll.....				
No. 1182U. "VELVET," medium thick, unprepared.				
Inches wide—	30	36	42	
Per 50-yard roll.....				
No. 1183U. "ALCO," medium thick, unprepared.				
Inches wide—	30	36	42	54
Per 50-yard roll				
No. 1184U. "PARCHMENT," thin, unprepared.				
Inches wide—	30	36	42	54
Per 50-yard roll				
No. 1185U. "PARCHMENT," medium thick, unprepared.				
Inches wide—	30	36	42	54
Per 50-yard roll.....				
No. 1190U. "ALCO CLOTH," medium thick, unprepared.				
Inches wide—	30	36	42	54
Per 10-yard roll				
No. 1191U. "ALCO CLOTH," thin, unprepared.				
Inches wide—	30	36	42	
Per 10-yard roll				

MOUNTING SERVICE

Mounting on cloth single sheets	sq. ft.
Mounting on cloth matched sheets	sq. ft.
Mounting on cloth cut to fold	sq. ft.
Mounting Geological sheets to fold..	each
Mounting Geological sheets, cloth.....	each
Mounting on Beaver Board.....	sq. ft.
Common sticks	lin. ft.
Half round sticks	lin. ft.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.



**PROCESS PRINTING
& MAP MOUNTING**



We have every facility for the prompt duplicating of drawings and tracings. Work entrusted to us will receive most careful attention.

BLUE PRINTING

	Per sq. ft.
P1. Paper prints from transparent drawings up to 42 in. wide.....	
P2. Paper prints from transparent drawings over 42 in. wide.....	
P3. Paper prints from opaque drawings up to 42 in. wide.....	
P4. Paper prints from profile tracing paper or cloth.....	
P5. Paper prints from profile drawing cloth.....	
P6. Paper prints from "Specifications" in lots of 25 or more, each..	
P7. Cloth prints from transparent drawings up to 42 in wide.....	
P8. Cloth prints from transparent drawings over 42 in. wide.....	

BLUE-LINE PRINTING FROM NEGATIVES

P9. Paper prints from negatives up to 42 in. wide.....	
P10. Paper prints from negatives over 42 in. wide.....	
P11. Cloth prints from negatives up to 42 in. wide.....	
P12. Cloth prints from negatives over 42 in. wide.....	

NEGATIVE PRINTING OR BROWN-LINE POSITIVE PRINTING

P13. Negative from Patent Office Drawing.....	
P14. Alco Solar Paper prints, negative or positive, up to 42 in. wide..	
P15. Alco Solar Paper Prints, negative or positive, over 42 in. wide..	
P16. Alco Solar Cloth prints, negative or positive, up to 42 in. wide..	
P17. Alco Solar, Cloth prints, negative or positive, over 42 in. wide... No bill rendered under 25c.	

LITHO PRINT PROCESS

A comparatively recent process by which tracings, either pencil or ink, can be printed upon tracing cloth, linaura cloth or papers of any desired thickness. It offers unlimited possibilities as can be appreciated from the fact that a tracing cloth copy can be made from a tracing, and from which in turn blue prints or negatives can be made if required. It being a dry process all shrinkage is overcome. It can be appreciated that this is important in certain classes of work since the shrinkage in blue printing is well understood and under the negative and blue-line processes is doubled.

	Per sq. ft.
LP1. Litho Prints on Tracing Cloth	
LP2. Litho Prints on Tracing Cloth, 3 or more from same copy.....	
LP3. Litho Prints on Tracing Paper	
LP4. Litho Prints on Tracing Paper, 3 or more from same copy.....	
LP5. Litho Prints on Drawing Cloth	
LP6. Litho Prints on Drawing Cloth, 3 or more from same copy..... Size limit 36x108 inches.	

See price list in back of catalog.

MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS THE A. LIETZ COMPANY
SAN FRANCISCO, U. S. A.

MAILING AND STORAGE TUBES



No. 1231

Made of tin for storing prepared papers and cloths, excluding light and moisture.

Inches long— 31 37 43 55

No. 1230. For 10-yard rolls (2-in. diameter) ea..

No. 1231. For 50-yard rolls (4-in. diameter) ea..



No. 1232

Made of stout pasteboard, with screw metal ends.
Inches long— 32 37 43

No. 1232. 2½-in. diameter; ea.....

TELESCOPE MAILING TUBES

Made of plain strawboard.

Inches long— 12 18 24 36 42 48

No. 1237. 2- in. diam.; ea.....

doz.....

No. 1238. 3- in. diam.; ea.....

doz.....

MAILING TUBES

Open ends, plain strawboard, spiral.

Inches long— 12 18 24 30 36 42

No. 1241. 1½-in diam.; ea.....

doz.....

No. 1242. 2- in. diam.; ea.....

doz.....

No. 1243. 2½-in. diam.; ea.....

doz.....

No. 1244. 3- in. diam.; ea.....

doz.....

Prices on large quantities or special mailing tubes furnished upon request.

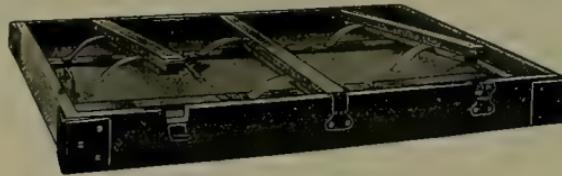
See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

BLUE PRINT FRAMES

FIRST QUALITY

Our Blue Print Frames are made of well seasoned oak, and are of the best workmanship. Finished in three-coat Golden Oak and black backs. Equipped with oil-tempered steel springs, iron corner plates and special bar catches which are rapidly operated without bruising the fingers.



	Clear Printing Surface	Outside Dimensions	Frame Only	Frame with Felt Pad	Frame with Pad and Polished Plate Glass
No. 1265A.	20x26	24 x30 x4 $\frac{1}{4}$			
No. 1265B.	24x30	28 x34 x4 $\frac{1}{4}$			
No. 1265C.	30x42	34 x46 x4 $\frac{1}{4}$			
No. 1265D.	36x48	40 x52 x5 $\frac{1}{2}$			
No. 1265E.	36x60	40 x64 x5 $\frac{1}{2}$			
No. 1265F.	42x60	46 $\frac{1}{2}$ x64 $\frac{1}{2}$ x6			
No. 1265G.	42x72	46 $\frac{1}{2}$ x76 $\frac{1}{2}$ x6			

All above prices cover crating for shipment.
Shipping weight, about 10 lbs. per square foot.

INSURANCE

We insure plate glass against breakage when requested to do so.
We are not responsible for breakage of glass in transit.

EXTRA PADS FOR BLUE PRINT FRAMES

Felt Pads $\frac{3}{8}$ -inch thick

No. 1266A.	20x26 in.	.....
No. 1266B.	24x30 in.	.....
No. 1266C.	30x42 in.	.....
No. 1266D.	36x48 in.	.....
No. 1266E.	36x60 in.	.....
No. 1266F.	42x60 in.	.....
No. 1266G.	42x72 in.	.....

Cotton Pads $\frac{3}{8}$ -inch thick

No. 1267A.	20x26 in.	.....
No. 1267B.	24x30 in.	.....
No. 1267C.	30x42 in.	.....
No. 1267D.	36x48 in.	.....
No. 1267E.	36x60 in.	.....
No. 1267F.	42x60 in.	.....
No. 1267G.	42x72 in.	.....

See price list in back of catalog.

SMALL BLUE PRINT FRAMES

Made of well seasoned white wood, locked corners, shellac finish. With oil-tempered steel springs, spring brass catches. A strong, light frame which can be easily handled.



No. 1271

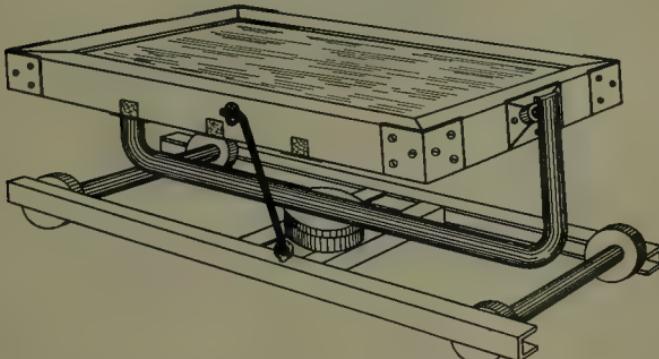
No. 1271.	Clear Printing Surface	Outside Dimensions	Frame Complete with Felt Pad and Double Thick Glass
	12x16 16x21	18½x17½ 17½x22½	

All above prices cover crating for shipment.

Shipping weight, about 10 lbs. per square foot.

We are not responsible for breakage of glass in transit.

BLUE PRINT CARS



No. 1275, Car Carrying Frame No. 1265

These cars may be used with or without tracks and carry the largest frames with ease. Cars are finished in black baked enamel and are made of strong iron. The frames are mounted on turntable and can be clamped at any angle. The frame is firmly held in position for loading.

When ordering car only, give outside dimensions of your frame. State whether for use on track.

	Approximate Price Shipping Wt. Car only
No. 1275A. Car for frames up to and including 30x42 in.....	140 lbs.
No. 1275B. Car for frames up to and including 42x72 in.....	150 lbs.
No. 1275C. Car for frames up to and including 48x100 in.....	160 lbs.

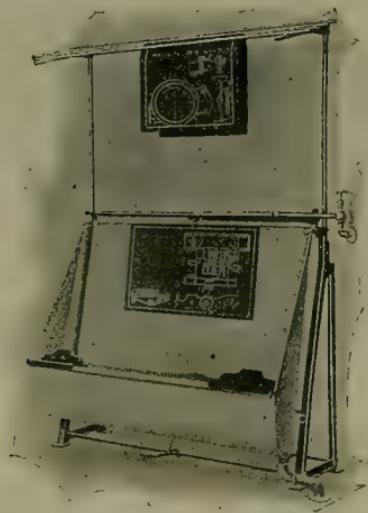
IMPORTANT

When ordering blue print car and track please state height and width of your window when open, width of window sill, height of window sill from floor, and thickness of wall. Also state size of your blue print frame when not ordering new frame.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

THE IMPROVED SHEET WASHER



The prints are washed with running water, entirely avoiding the use of flat tanks which occupy a great deal of space and in which the water soon becomes foul with chemicals and unfit for use.

The method of washing is to fold the prints over one of the rods provided and hang it in the tray under the spray of water. In this position both sides of the print are thoroughly washed, after which it is suspended on the rack to dry. Provision is made for holding small prints under the spray without a rod. The prints being wet on the printed side only dry in one-third the time required when washed in trays, and are much less distorted. The Improved Sheet Washer saves time and space, occupying a floor space of only $4\frac{1}{2} \times 2$ feet, washes the prints perfectly, and avoids dripping prints and wet floors.

No. 1278. Improved Sheet Washer for prints up to and including 48x72 inches.
Code Word, **KAFFIR**

See price list in back of catalog.

ZINC BATH TRAYS



No. 1280

No. 1280.	Plain Zinc Bath Tray with strongly wired rim and drain pipe,	Each
12x17 inches	
17x22 inches	
20x24 inches	
24x30 inches	



No. 1281

No. 1281.	Zinc Bath Tray with strongly wired rim, drain pipe and wooden braces,	Each
20x24 inches	
24x30 inches	
30x42 inches	
36x48 inches	
36x60 inches	
42x60 inches	
42x72 inches	

Prices cover cost of crating for shipment.

See price list in back of catalog.

WICKES CONTINUOUS ELECTRIC BLUE PRINTING MACHINES



Will make prints up to and including 48 inches in width and of unlimited length.

The Wickes Continuous Electric Blue Print Machines are made in two models.

Model 20 has a capacity of about 550 square yards of blue prints per day, or a printing speed of from 1" to 30" per minute. It has two lighting elements on separate switches.

Model 15 is constructed exactly like Model 20, but has only one lighting element and a printing speed of from 1" to 15" per minute. It is so arranged that another lamp can be added later, changing it to a model 20.

These machines are simple in construction, entirely self-contained, require no dark room, occupy a minimum floor space of only $2\frac{1}{2} \times 5$ feet, (30" high), and use less than half the amount of current as the average vertical electric printer and less than one-tenth the amount of current as a 48" Continuous Printer with five arc lamps. The cylinder is

constructed of spirally disposed wires which give the prints a spreading and smoothing effect, assuring of good contact. Thus, also, the danger of breaking the cylinder, which in other machines is usually made of glass, is entirely eliminated. The light is obtained from mercury vapor lamps of standard pattern.

- No. 1307.** Wickes Continuous Electric Blue Printing Machine, Model 15 Code Word, **KALMUCK**
- No. 1308.** Wickes Continuous Electric Blue Printing Machine, Model 20 Code Word, **KAOLIN**

These machines are equipped for either direct or alternating current. If required for 25 cycles or any special current an additional charge of \$15.00 is made for model 15 and \$25.00 for model 20. When ordering please specify current, if alternating or direct. If alternating give frequency of cycles.

Complete booklet fully describing and illustrating the Wickes Continuous Electric Blue Printing Machines will be sent upon request.

- No. 1309.** Extra Mercury Vapor Lamps for Wickes Blue Printing Machines. Code Word, **KARYO**

Above prices cover crating for shipment.

See price list in back of catalog.

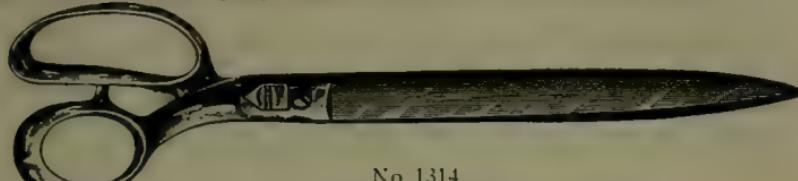
MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS THE A. LIETZ COMPANY
SAN FRANCISCO, U. S. A.

BLUE PRINT ROOM REQUISITES



No. 1312

No. 1312. Wooden Spring Clips for clamping prints when drying. Doz.



No. 1314

No. 1314. Trimming Shears, nickel-plated. Size, inches— 8 10 12 14 16
Each



No. 1316

No. 1316. Print Trimmers, highest quality, curved steel blade, polished hard-wood board. Size of blade, inches..... 8 10 12 15 18 24
Each



No. 1317

No. 1317. "Crescent" Paper Trimmer, 33-inch blade, for attaching to end of cutting table, each.....

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

SPECIFICATION AND AGREEMENT FORMS

S	19
<i>To</i>	
This is to Certify, That _____	
Contractor for the _____	of _____
entitled to a payment of	
DOLLARS,	
by the terms of Contract.	
Contract Price . . \$ _____	SUPERINTENDENT
Extra Work . . \$ _____	
Total Am't issued. \$ _____	
Balance . . \$ _____	
Remarks: _____	

No. 1330

Each

No. 1330. Architects' Certificate Books, book of 100 with stubs.....

BLANK FORMS

No. 1332. Standard Blank Form Specifications, consisting of the following 14 forms in strong manila cover:

Preamble	Heating, Steam or Hot Water
Masons, Cut Stone	Heating, Furnace
Plasterers	Electric Wiring
Carpenters	Agreement between Owner and Contractor (with bond)
Painters, Glaziers	Contractor's Statement
Plumbers, Gas Fitters, Sewers	Architect's Reminder (on inside of cover)
Galvanized Iron	
Iron (Structural) :	
Per 100 sets ..	Per dozen sets....
	Each set....

STANDARD DOCUMENTS

A series of new contract documents, replacing the old uniform contracts which have been discontinued. These forms have been approved by the directors of the American Institute of Architects and National Association of Builders' Exchanges.

Per 100 Each

No. 1335A.	Agreement and General Conditions
No. 1335B.	General Conditions without Agreement
No. 1335C.	Bond of Suretyship
No. 1335D.	Form of Subcontract
No. 1335E.	Letter of Acceptance of Subcontractor's Proposal
No. 1335F.	Agreement between Architect and Owner, per cent basis
No. 1335G.	Agreement between Contractor and Owner when stipulated sum is basis of payment
No. 1336.	Set, complete, Nos. 1335A-1335G, in heavy paper cover with explanatory notes

See price list in back of catalog.

DRAWING INSTRUMENTS

FACTS TO BE CONSIDERED IN SELECTING

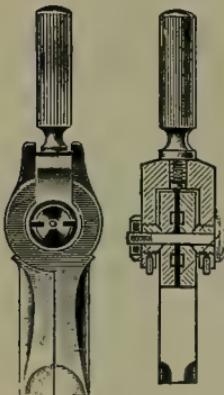
The *varieties* and qualities of drawing instruments are now so numerous and the finish in all so very similar, even though the intrinsic values are far greater in some than in others, that it is sometimes difficult to grasp the actual and comparative values of an instrument.

The *quality* can be determined only by the efficiency and durability of the instrument in actual use. The life and efficiency of drawing instruments depend entirely upon the qualities of the materials or metals employed in their manufacture and *not on the finish*; upon careful and conscientious workmanship and on their design and general form. Our stock includes a variety of instruments that will fully meet all requirements of the professional man and the student. The merits of each line are fully explained on the following pages.

**DESCRIPTION OF VARIOUS QUALITIES
ALSO PARAMOUNT DRAWING INSTRUMENTS**

The material employed in the manufacture of this line is the finest hard rolled nickel-silver *wrought metal*, and the highest grade of tool steel to be had in the market. The finish is silver white and remarkably fine, neither labor nor expense having been spared.

PATENTED STRAIGHTENING DEVICE



Embodying improved pivot joint construction; head true and nicely fitted. The design permits a very fine and easy adjustment of the joint and will never become loose.

**REPLACEABLE STEEL POINTS
ON DIVIDERS**



Steel points are so made that they can readily be interchanged or replaced by simply turning the clamp screw, overcoming thereby the troublesome regrinding of broken points.

RULING PENS

The material used is especially hard, being properly tempered. It will give the best results and long wear.

SLIDE CATCH OPENING DEVICE FOR RULING PENS



closed



open

This device allows an immediate opening, thorough cleaning and closing of pens to their previous position without touching the screw. By moving the slide towards the handle the blades are thrown open for cleaning. The pen is closed by pressing together both blades and returning the slide to its previous position.

BOW INSTRUMENTS

The Alco Paramount Bow Instruments are constructed of one piece of steel properly tempered. The handles are nickel-silver and all threads are uniform, made of the best workmanship and finish.

ALCO "CIRCLE A" DRAWING INSTRUMENTS

The merits of these instruments are fully stated on pages 272 to 275.

ALCO "SUPERIOR" DRAWING INSTRUMENTS

These instruments are similar in design to the Alco Paramount Drawing Instruments. They are high grade in every respect, made of hard-rolled German silver and highest grade tool steel, first-class workmanship and finish.

ALCO "CIRCLE T" DRAWING INSTRUMENTS

A very popular line of exceptional value. They are guaranteed to be perfectly assembled and nicely fitted and to give satisfactory results. Made of hard-rolled German silver and tool steel.

ALCO "UNIVERSAL" DRAWING INSTRUMENTS

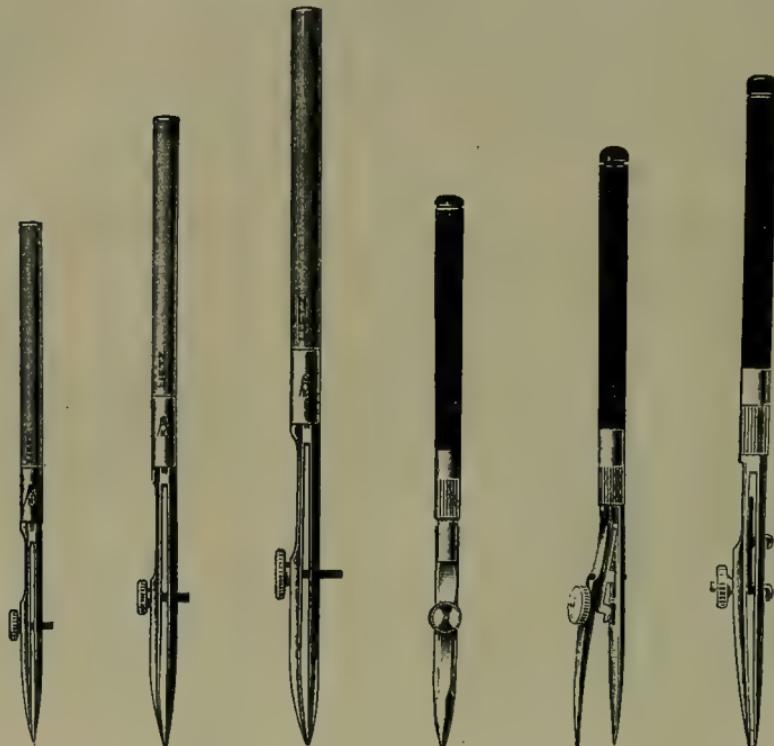
These are of excellent design. With proper care will give long and satisfactory service; made of hard-rolled German silver and tool steel. For the purposes of the student or one having only occasional need for drawing instruments, this line is admirably adapted.

ALCO "JUNIOR" DRAWING INSTRUMENTS

Made of good quality German silver and steel points. Due to their low cost and excellent features, this line is very popular for use in the Manual Training Schools.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

ALCO PARAMOUNT DRAWING INSTRUMENTS



No. 1400A No. 1401A No. 1402A No. 1400SC No. 1401SC No. 1402SC

Each

No. 1400.	Ruling Pen, 4½ in., upper blade with spring, ebony handle
No. 1401.	Ruling Pen, 5 in., upper blade with spring, ebony handle
No. 1402.	Ruling Pen, 5½ in., upper blade with spring, ebony handle
No. 1400A.	Ruling Pen, 4½ in., upper blade with spring, aluminum handle
No. 1401A.	Ruling Pen, 5 in., upper blade with spring, aluminum handle
No. 1402A.	Ruling Pen, 5½ in., upper blade with spring, aluminum handle
No. 1400SC.	Ruling Pen, 4½ in., slide catch opening, ebony handle....
No. 1401SC.	Ruling Pen, 5 in., slide catch opening, ebony handle....
No. 1402SC.	Ruling Pen, 5½ in., slide catch opening, ebony handle....

See price list in back of catalog.

ALCO PARAMOUNT DRAWING INSTRUMENTS



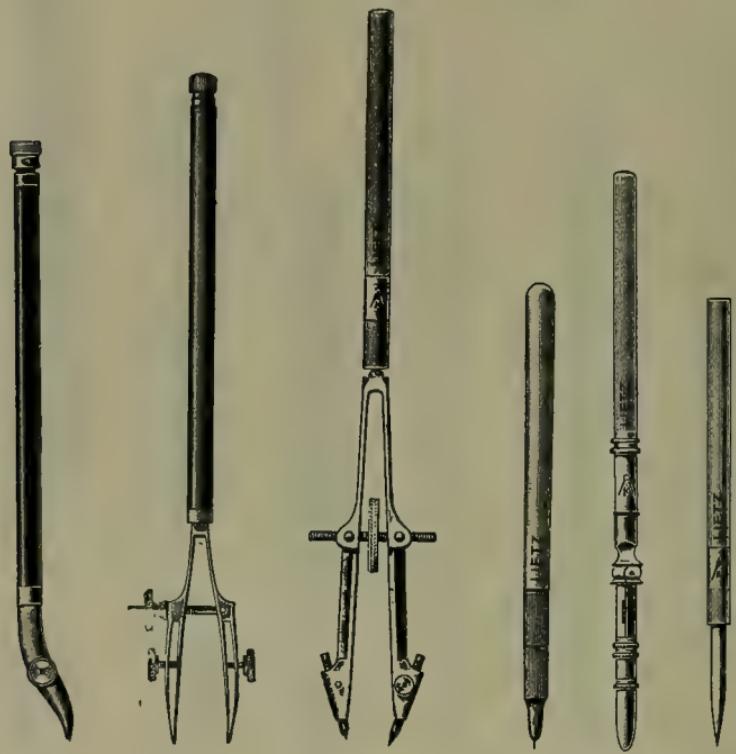
No. 1406	No. 1407	No. 1408	No. 1410	No. 1411	No. 1412	Each
No. 1406.	Ruling Pen, 4½ in., with joint and pin, ebony handle...					
No. 1407.	Ruling Pen, 5 in., with joint and pin, ebony handle...					
No. 1408.	Ruling Pen, 5½ in., with joint and pin, ebony handle...					
No. 1410.	Swedish Drawing Pen, 5 in., for broad lines, ebony handle					
No. 1411.	Swedish Drawing Pen, 6 in., for broad lines, ebony handle					
No. 1412.	Swedish Drawing Pen, 7 in., for broad lines, ebony handle					
No. 1410A.	Swedish Drawing Pen, 5 in., for broad lines, aluminum handle					
No. 1411A.	Swedish Drawing Pen, 6 in., for broad lines, aluminum handle					
No. 1412A.	Swedish Drawing Pen, 7 in., for broad lines, aluminum handle					

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

ALCO PARAMOUNT DRAWING INSTRUMENTS

Each instrument stamped with trade mark.



	Each
No. 1414. *Curve Pen, metal handle, 4½ in.....
No. 1415. *Swivel Railroad Pen, metal handle, 5¼ in.
No. 1416. Railroad Pencil, improved center adjustment, aluminum handle, 5½ in.
No. 1424. Pricker, ebony handle
No. 1425. Pricker, aluminum handle, disappearing needle point with cap
No. 1426. Tracer, aluminum handle

*Pens Nos. 1414 and 1415 are fastened to a rod which swivels in the hollow handle and thus follows the smallest curve with precision. The rod may be locked by means of a nut at the upper end, and the instrument may be used as an ordinary drawing or railroad pen.

See price list in back of catalog.

ALCO PARAMOUNT DRAWING INSTRUMENTS



No. 1430S

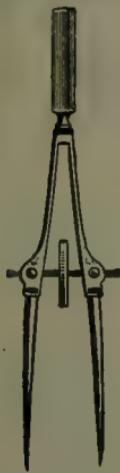


No. 1432S

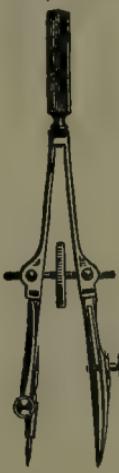


No. 1434S

- No. 1430S.** Steel Spring Bow Divider, German silver handle, 3½ in...
No. 1432S. Steel Spring Bow Pen, German silver handle, 3½ in....
No. 1434S. Steel Spring Bow Pencil, German silver handle, 3½ in...



No. 1440C



No. 1442C

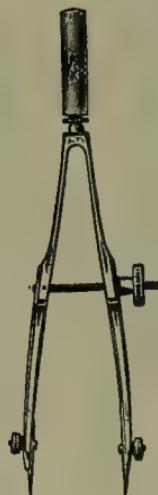


No. 1444C

- No. 1440C.** Bow Divider, center adjustment, removable steel points, German silver handle and legs, 3½ in.....
No. 1442C. Bow Pen, center adjustment, German silver handle and legs, 3½ in.
No. 1444C. Bow Pencil, center adjustment, German silver handle and legs, 3½ in.

See price list in back of catalog.

ALCO PARAMOUNT DRAWING INSTRUMENTS



No. 1451



No. 1452



No. 1454

- No. 1451.** Steel Spring Bow Dividers with needle points, German silver handle, 4 in.....
- No. 1452.** Steel Spring Bow Pen with needle point, German silver handle, 4 in.....
- No. 1454.** Steel Spring Bow Pencil with needle point, German silver handle, 4 in.....
- No. 1454C.** Set of three Steel Spring Bow Instruments, Nos. 1450, 1452 and 1454, in Morocco case

Each

See price list in back of catalog.

ALCO PARAMOUNT DRAWING INSTRUMENTS



No. 1461



No. 1462



No. 1464

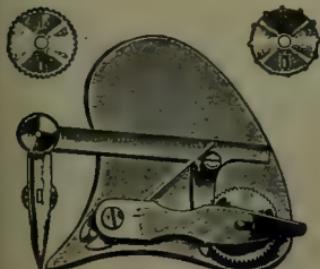
Each

No. 1461. Steel Spring Bow Dividers with needle points, German silver handle, 4 in.

No. 1462. Steel Spring Bow Pen with needle point, German silver handle, 4 in.

No. 1464. Steel Spring Bow Pencil with needle point, German silver handle, 4 in.

No. 1464C. Set of three Steel Spring Bow Instruments, Nos. 1461, 1462 and 1464, in morocco case.



No. 1465D

DOTTING INSTRUMENT

No. 1465D. Dotting Instrument with three wheels in case. Each.....

By throwing back the spring, the wheels of different patterns are inserted. The wheel is rolled on the edge of a T-square or straight-edge and causes the pen by means of a ratchet wheel to move up and down.

See price list in back of catalog.

ALCO PARAMOUNT DRAWING INSTRUMENTS



No. 1466



No. 1467



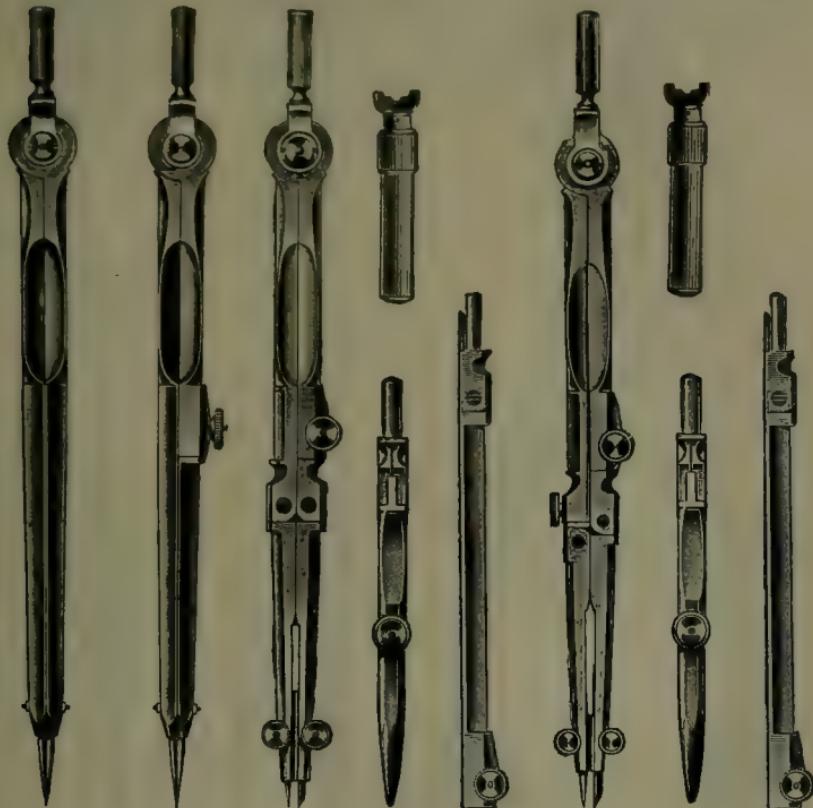
No. 1472NL

Each

- No. 1466.** Rotating Drop Bow Instrument, self-adjusting, for very small circles, $4\frac{1}{4}$ in.....
- No. 1466C.** Same as No. 1466, in velvet-lined case.....
- No. 1467.** Rotating Drop Bow Instrument, like No. 1466, but with pencil part
- No. 1467C.** Same as No. 1467, in velvet-lined case.....
- No. 1472NL.** Compass, $4\frac{1}{4}$ in., with fixed needle point, pen and pencil parts and lengthening bar.....
No. 1472NL is equipped with straightening device.

See price list in back of catalog.

ALCO PARAMOUNT DRAWING INSTRUMENTS



No. 1470-2 No. 1471

No. 1474 3/4

No. 1474 3/4 H

Each

No. 1470-2. Plain Divider, 6 in., with removable steel points**No. 1471.** Hairspring Divider, 6 in., with removable steel points..**No. 1474 3/4.** Compass, 6 in., with fixed needle point, pen and pencil parts and lengthening bar.....**No. 1474 3/4 H.** Hairspring Compass, 6 in., with fixed needle point, pen and pencil parts and lengthening bar.....

All Dividers and Compasses equipped with straightening device.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

**EXTRA PARTS FOR
ALCO PARAMOUNT DRAWING INSTRUMENTS**

No.	Description	Each
1485-4.	Combination Key and Lead Box.....	
5.	Metal handle for needle, pen or pencil parts of small compasses	
6.	Metal handle for parts of large compasses.....	
7.	Center Tack	
8.	Ebony handle for ruling pens.....	
9.	Aluminum Handle for ruling pens.....	
10.	Ivory Handle for ruling pens.....	
11.	German Silver Handle for bow instruments.....	
13.	Screws or Bolt and Nut for pens.....	
13½.	Slide Catch Device for pens.....	
14.	Bolts for side motion bow instruments.....	
15.	Center Motion Screw with left and right thread.....	
17.	Pencil Part for No. 1467, etc.....	
18.	Pen Part for No. 1467, etc.....	
20.	Divider or Needle Point Part for No. 1472, etc.....	
21.	Pencil Part for No. 1472, etc.....	
22.	Pen Part for No. 1472, etc.....	
23.	Divider or Needle Point Part for No. 1484, etc.....	
24.	Pencil Part for No. 1484, etc.....	
25.	Pen Part for No. 1484, etc.....	
26.	Lengthening Bar for 4¾-in. Compasses.....	
27.	Lengthening Bar for 6-in. Compasses.....	



1486



1486R



1487 1489-A B C D E F

Each

No. 1486.	Horn Center, $\frac{1}{2}$ -inch diameter, plain, for resting compass or divider over given point
No. 1486R.	Horn Center, $\frac{3}{4}$ -inch diameter, with German silver rim...
No. 1487A.	German Silver Box containing leads for instruments.....
No. 1487B.	Tin Box containing three leads for instruments.....
No. 1489.	Extra Needle Points for instruments (order by letter)...

See price list in back of catalog.

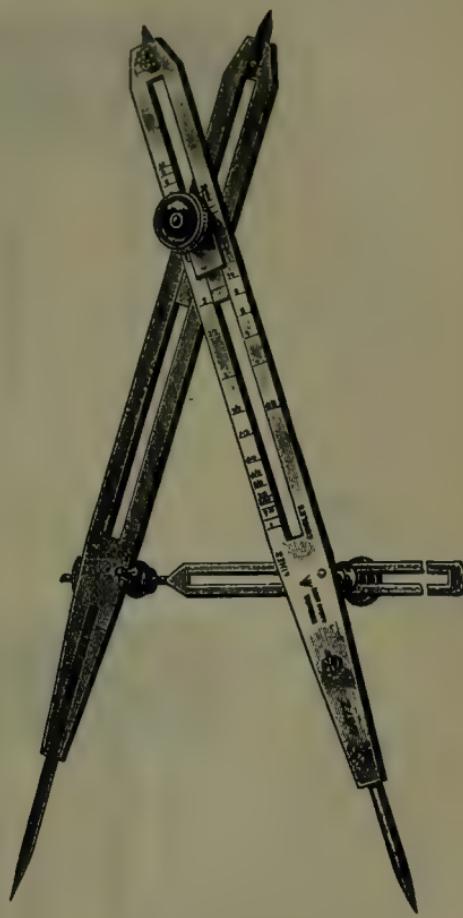
ALCO PARAMOUNT DRAWING INSTRUMENTS



No. 1490



No. 1491



Nos. 1492-1493

Each

No. 1490. Proportional Dividers, 8 in., with movable points, finely divided for lines and circles.....

No. 1491. Proportional Dividers, 8 in., with movable points, rack movement, finely divided for lines and circles.....

No. 1492. Proportional Dividers, 8 in., with movable points, micrometer adjustment, finely divided for lines and circles.....

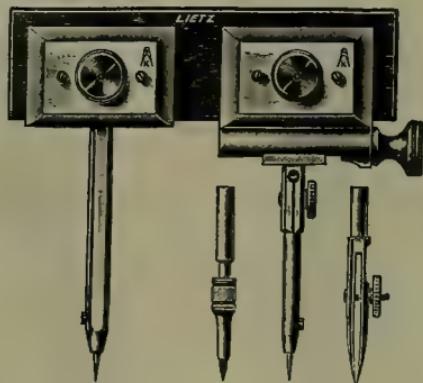
No. 1493. Proportional Dividers, 8 in., with movable points, micrometer adjustment, finely divided for lines, circles, planes and solids

No. 1490C. Cases, velvet lined, with bar lock for Proportional Dividers Nos. 1490-1493

For other Proportional Dividers see pages 297 and 318.

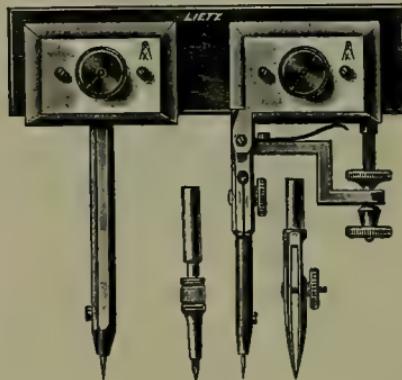
See price list in back of catalog.

ALCO PARAMOUNT DRAWING INSTRUMENTS



No. 1495C

No. 1495C. Beam Compass with two steel points, pen and pencil parts, lateral micrometer adjustment in velvet-lined case.....



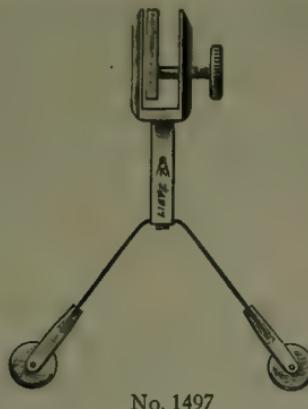
No. 1496C

No. 1496C. Beam Compass with two steel points, pen and pencil parts, vertical micrometer adjustment, in velvet-lined case.....

For other Beam Compasses see pages 298 to 299.

See price list in back of catalog.

ALCO PARAMOUNT DRAWING INSTRUMENTS



No. 1497

No. 1497.	Wheel attachment or balance for Beam Compasses Nos. 1495 and 1496	Each
No. 1497C.	Case only, velvet lined, to contain Beam Compass No. 1495 and attachment No. 1497.....	
No. 1498C.	Case only, velvet-lined, to contain Beam Compass No. 1496 and attachment No. 1497.....	

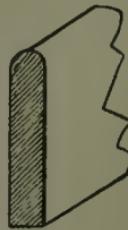
BARS FOR BEAM COMPASSES



No. 1499A



No. 1499B



No. 1499C

Inches—

No. 1499A.	Hardwood.	Each	24	30	36	42	48	60
No. 1499B.	Hardwood.	Each						
No. 1499C.	Hardwood.	Each						

If possible please state for which instrument beam is intended.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

ALCO "PARAMOUNT" DRAWING INSTRUMENTS
In Finest Morocco Pocket Book Cases



No. 1500PB

No. 1500PB. Pocket Book Case, velvet lined, containing:

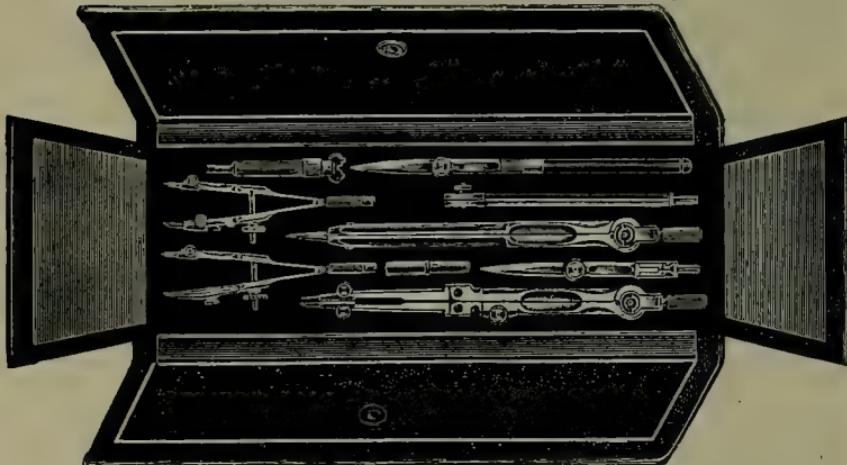
No. 1402. Ruling Pen, $5\frac{1}{2}$ in.

No. 1474 $\frac{3}{4}$. Compass, 6 in., with fixed needle point, pen and pencil parts and lengthening bar.

No. 1470-2. Plain Divider, 6 in., with removable steel point.

No. 1485-4. Combination key and lead box.

Per set Code Word, **MACHAN**



No. 1503PB

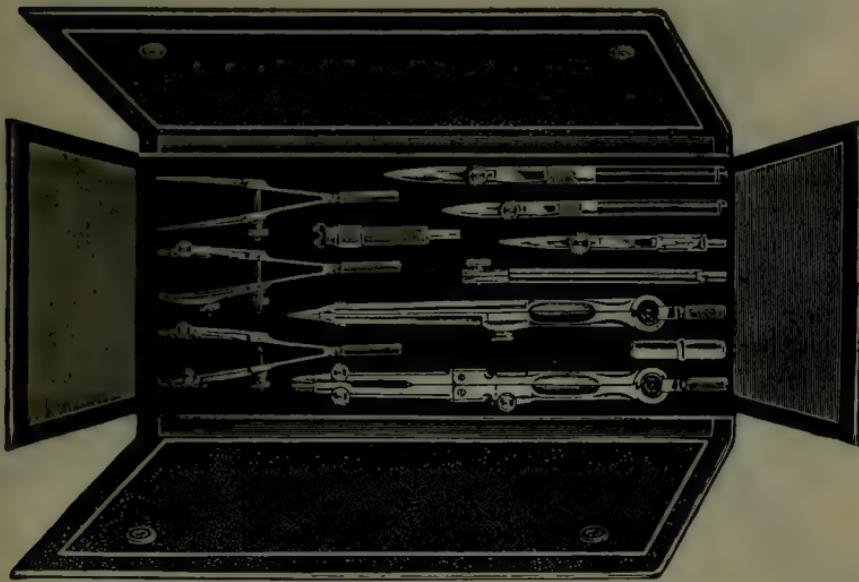
No. 1503PB. Pocket Book Case, velvet-lined, containing same assortment as No. 1500PB, and in addition two bow instruments Nos. 1432S and 1434S. Per set Code Word, **MACKLE**

All Dividers and Compasses equipped with straightening device.

See price list in back of catalog.

ALCO PARAMOUNT DRAWING INSTRUMENTS

In Finest Morocco Pocket Book Cases.



No. 1504PB.

No. 1504PB. Pocket Book Case, velvet-lined, containing:

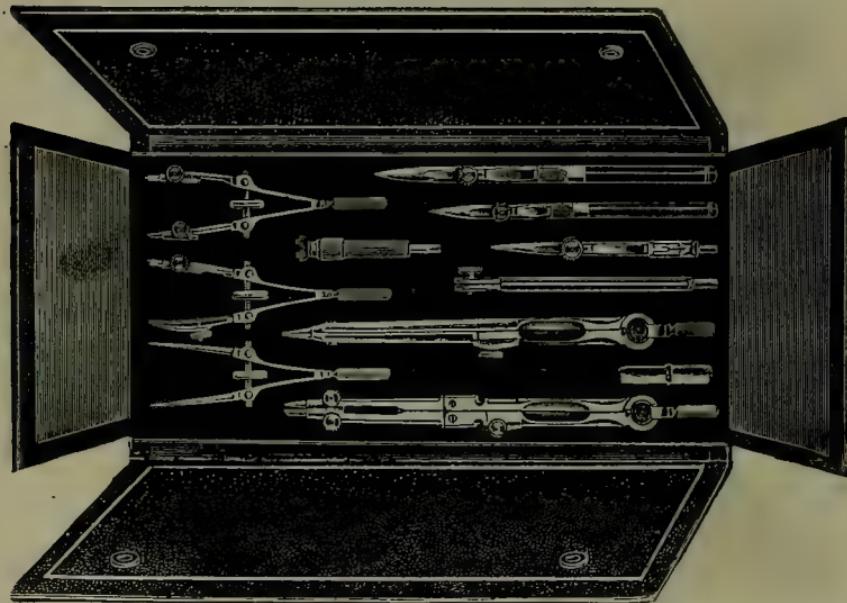
- | | |
|--------------------|---|
| No. 1400. | Drawing Pen, 4½ in., upper blade with spring,
ebony handle |
| No. 1402. | Drawing Pen, 5½ in., upper blade with spring,
ebony handle |
| No. 1430S. | Steel Spring Bow Divider, 3½ in., metal handle.. |
| No. 1432S. | Steel Spring Bow Pen, 3½ in., metal handle.. |
| No. 1434S. | Steel Spring Bow Pencil, 3½ in., metal handle... |
| No. 1471. | Hairspring Divider, 6 in., with removable steel
points. |
| No. 1474 ¾. | Compass, 6 in., with fixed needle point, pen and
pencil parts and lengthening bar..... |
| No. 1485-4. | Combination Key and Lead Box.....
Per setCode Word, MACRON |

All Dividers and Compasses equipped with straightening device.

See price list in back of catalog.

ALCO PARAMOUNT DRAWING INSTRUMENTS

In Finest Morocco Pocket Book Cases.



No. 1505PB

No. 1505PB. Pocket Book Case, velvet-lined, containing:

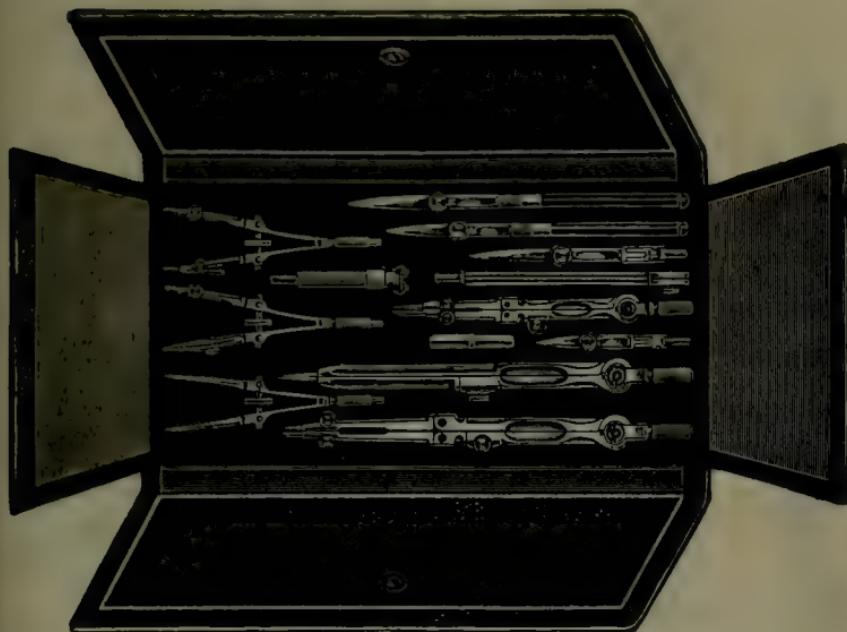
No. 1400.	Drawing Pen, 4½ in., upper blade with spring, ebony handle
No. 1402.	Drawing Pen, 5½ in., upper blade with spring, ebony handle
No. 1440C.	Steel Spring Bow Divider, center adjustment, 3½ in., metal handle
No. 1442C.	Steel Spring Bow Pen, center adjustment, 3½ in., metal handle
No. 1444C.	Steel Spring Bow Pencil, center adjustment, 3½ in., metal handle
No. 1471.	Hairspring Divider, 6 in., with removable steel points
No. 1474 ¾.	Compass, 6 in., with fixed needle point, pen and pencil parts and lengthening bar.....
No. 1485-4.	Combination Key and Lead Box. Per set Code Word, MADCAP

All Dividers and Compasses equipped with straightening device.

See price list in back of catalog.

ALCO PARAMOUNT DRAWING INSTRUMENTS

In Finest Morocco Pocket Book Cases.



No. 1508PB

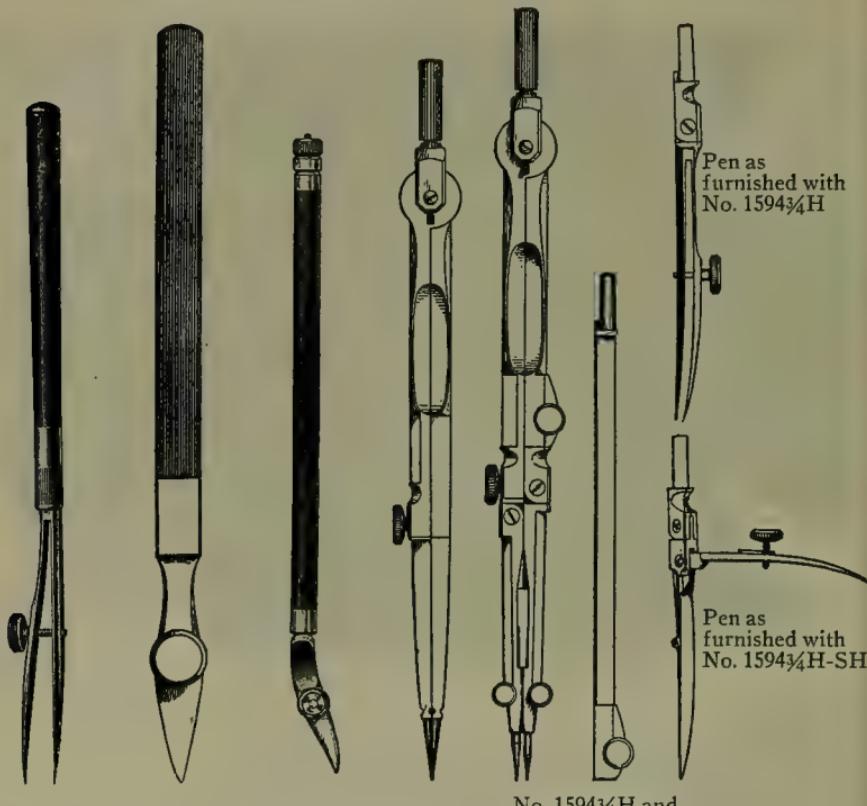
No. 1508PB. Pocket Book Case, velvet-lined, containing:

No. 1400.	Ruling Pen, 4½ in., ebony handle.....
No. 1402.	Ruling Pen, 5½ in., ebony handle.....
No. 1440C.	Spring Bow Divider, 3½ in., center motion.....
No. 1442C.	Spring Bow Pen, 3½ in., center motion.....
No. 1444C.	Spring Bow Pencil, 3½ in., center motion.....
No. 1471.	Hair Spring Divider, 6 in., with removable steel points
No. 1472.	Compass, 4¼ in., with fixed needle points, pen and pencil parts, without lengthening bar.....
No. 1474 ¾.	Compass, 6 in., with fixed needle point, pen and pencil parts, lengthening bar.....
No. 1485-4.	Combination Key and Lead Box..... Per set .....Code Word, MAGENTA

See price list in back of catalog.

ALTENEDER'S DRAWING INSTRUMENTS

Each instrument is stamped T. A. or T. A. & Sons.



No. 1551 No. 1561 No. 1564 No. 1591 No. 1594 3/4 H and
No. 1594 3/4 H-SH

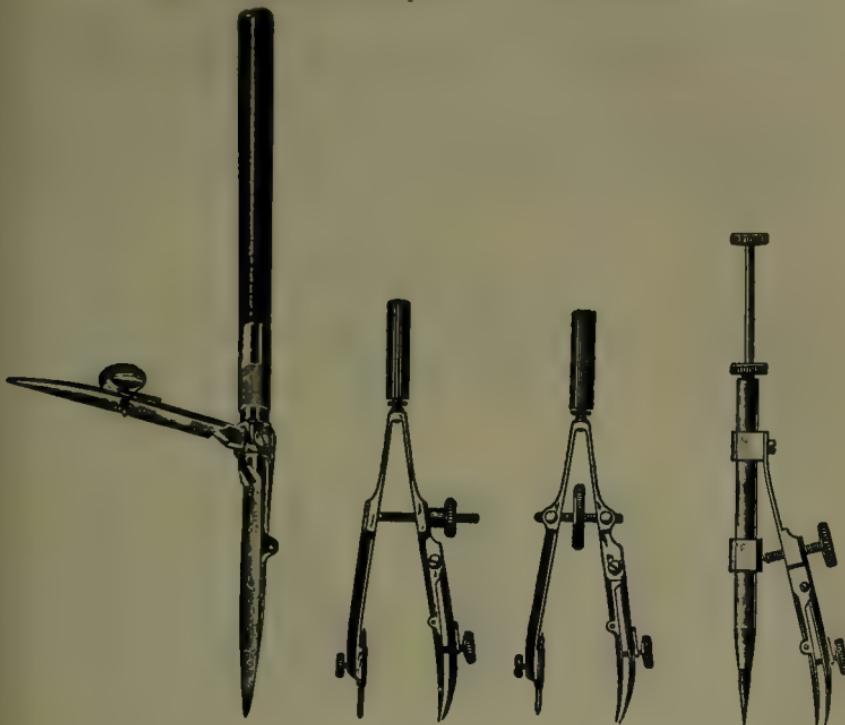
Each

- No. 1550.** Ruling Pen, 4 1/4 in., upper blade with spring, ebony handle..
- No. 1551.** Ruling Pen, 5 in., upper blade with spring, ebony handle..
- No. 1552.** Ruling Pen, 5 1/2 in., upper blade with spring, ebony handle..
- No. 1560.** Swedish Ruling Pen, 5 in., ebony handle.....
- No. 1561.** Swedish Ruling Pen, 6 in., ebony handle.....
- No. 1562.** Swedish Ruling Pen, 7 in., ebony handle.....
- No. 1564.** Curve Pen, 4 3/4 in., hollow metal handle.....
- No. 1591.** Hairspring Divider, 5 in.....
- No. 1594 3/4 H.** Compass, 5 1/2 in., Hairspring, with fixed needle point (leg), pen and pencil parts and lengthening bar.....
- No. 1594 3/4 H-SH.** Same as No. 1594 3/4 H, but with Patent Spring Hinge Pen

See price list in back of catalog.

ALTENEDER'S DRAWING INSTRUMENTS

Each instrument is stamped T. A. or T. A. & Sons.



No. 1557SH

No. 1572SH

No. 1582SH

No. 1586SH

Each

No. 1556SH.	Spring Hinge Ruling Pen, 4½ in., ebony handle.
No. 1557SH.	Spring Hinge Ruling Pen, 5 in., ebony handle.
No. 1558SH.	Spring Hinge Ruling Pen, 5½ in., ebony handle.
No. 1556A-SH.	Spring Hinge Ruling Pen, 4½ in., aluminum handle.
No. 1557A-SH.	Spring Hinge Ruling Pen, 5 in., aluminum handle.
No. 1558A-SH.	Spring Hinge Ruling Pen, 5½ in., aluminum handle.
No. 1570.	Steel Spring Bow Divider with plain steel points, German silver handle, 8¼ in.
No. 1571.	Steel Spring Bow Divider with needle points, German silver handle, 8¼ in.
No. 1572.	Steel Spring Bow Pen, German silver handle, 3½ in.
No. 1572SH.	Steel Spring Bow Pen with spring hinge, German silver handle, 8¼ in.
No. 1574.	Steel Spring Bow Pencil, German silver handle, 3½ in.
No. 1580.	Steel Spring Bow Divider, center motion, with plain steel points, German silver handle, 8¼ in.
No. 1581.	Steel Spring Bow Divider, center motion, with needle points, German silver handle, 8¼ in.
No. 1582.	Steel Spring Bow Pen, center motion, German silver handle, 8¼ in.
No. 1582SH.	Steel Spring Bow Pen, center motion, with spring hinge, German silver handle, 8¼ in.
No. 1584.	Steel Spring Bow Pencil, center motion, German silver handle, 8¼ in.
No. 1586SH.	Rotating Drop Bow Pen with spring hinge, 4 in.
No. 1587SH.	Rotating Drop Bow Instrument, like No. 1586SH but with pencil part.

See price list in back of catalog.

ALCO "CIRCLE A" DRAWING INSTRUMENTS

Each instrument stamped Alco "Circle A."

The one point of great importance about ALCO "Circle A" Drawing Instruments is that they are all made to gauge, all parts being interchangeable. The materials used are very finest quality of rolled German silver and best steel.

COMPASSES AND DIVIDERS

The foremost requirement in Compasses and Dividers intended for high-class work is an absolutely true and steady joint. By reason of their construction the joints of our ALCO "Circle A" Compasses can never become loose or work unevenly; it permits of exact adjustment and may readily be oiled. The construction is shown in the accompanying illustrations. Fig. 1 shows the plain joint while Fig. 2 illustrates the joint in connection with our straightening device.



Fig. 1



Fig. 2



Fig. 3

The shanks of the Compasses, which are centrically connected by a bipartite pivot showing a rounded head on either side, are enclosed by a fork carrying corresponding cavities on either side of its inner surface to receive the rounded heads of the pivots. The ends of the fork are drawn together by a screw passing between the legs of the compasses, by means of which the tension can be minutely regulated.

The shanks of the compasses are thus held together, not by the natural and therefore transient elasticity of the fork, but by the permanent pressure exerted by the screw. This construction warrants a true and smooth action at all times.

The straightening device forces the handle to remain in a central position to the legs. The construction will be clear by reference to Fig. 3.

ALCO "CIRCLE A" DRAWING INSTRUMENTS

Each instrument stamped Alco "Circle A."

The manner by which pen, pencil and needle point parts are held in place in their socket is very simple, but at the same time effective, so that these parts can never get shaky (See Fig. 4). The socket is split and the two sides being drawn together by a T-bolt screw clamp the inserted parts firmly in place.



Fig. 4

Fig. 5

All Compasses are supplied with needle point parts; these when inserted turn the instruments into perfect Dividers. One of the legs is provided with a needle point held in a split reversible sleeve (Fig. 5), so that either a plain or shouldered point may be used. The points can always be adjusted to a position perpendicular to the paper regardless of the opening and without any noticeable shortening of the leg, in this way avoiding sliding and misplacing of the center point and allowing the instrument to be used on a considerably larger radius than is possible with the old style Compasses, the lengthening bar being dispensable.

All needle points have extremely fine and sharp points, allowing of accurate spacing and leaving only the slightest marks on the paper. They are not ordinary sewing needles, but are specially made for the instruments from best hardened steel.

In all of the ALCO "Circle A" Drawing Instruments the steel points are removable. They are held in place by small clamp screws and can be exchanged very easily by giving the heads of the screws half a turn with the screwdriver. The troublesome regrinding of broken points is entirely done away with. If a point is worn or damaged it can be replaced by a new one. Reserve points are supplied with every set of instruments.

The Compasses and Dividers are of the flat-half-round type. Corners and sharp edges are avoided as much as possible to make the handling more pleasant. Screws are placed between the legs so as not to obstruct the view when drawing.

ALCO "CIRCLE A" DRAWING INSTRUMENTS

Each instrument stamped Alco "Circle A."

Another great advantage of the ALCO "Circle A" Drawing Instruments is the interchangeableness of all parts. Not only pen and pencil points of one pair of Compasses will fit exactly into any other of the same size; the legs or any other parts of one instrument fit perfectly into any other, sizes, of course, being equal.

With all Compasses ordered in cases a screwdriver serving as leadbox and a metal handle is furnished whose hollow space holds several reserve needle points. This handle serves for inserting pen, pencil or needle point part, so that each of them may be used as a separate instrument.

SPRING BOW INSTRUMENTS

Are made in two distinctly different styles:

Style A. Instruments with ANNULAR spring, Fig. A (new style).

Style B. Instruments with FLAT spring, Fig. B (old style).

We stock only the style A instruments.

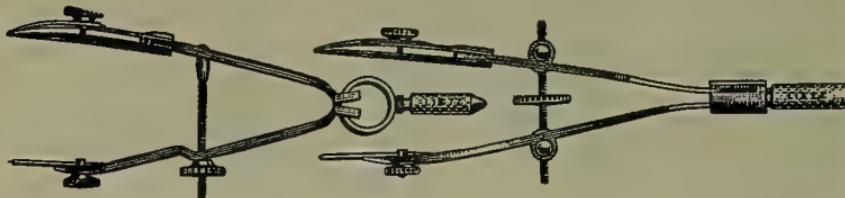


Fig. A

Fig. B

Both styles are fitted either with side or center screw adjustment.

Bow instruments of the annular spring construction have the great advantage that the tension of the shanks remains nearly constant for any spread while Bows with flat springs (old style) become slack the more they are opened. The shanks are made of German silver in this construction, whereby rusting is avoided.

The threads of the adjusting screws are all cut very deep and coarse, especially those of the center adjustment Bows, to insure quick motion and to avoid the disagreeable stripping.

All Steel Points Are Removable

All Bows have instruments comparatively widespread, especially with the 4½-in. Bows, so a good deal of work may be done for which the heavier Compasses usually are too clumsy.

ALCO "CIRCLE A" DRAWING INSTRUMENTS

Each instrument stamped ALCO "Circle A."

Bow Instrument No. 1665 is a very serviceable complete pocket set for small work. In connection with the metal handle it contains all the instruments needed by a draughtsman for this kind of work.

IMPROVED ROTATING BOW PENS



All Rotating Compasses of the ordinary type have the disadvantage that the pen or pencil points move in an arc relative to the center point, and since a pen will draw properly only at one certain position to the paper, it follows that the angular changes occurring in the position of the pen point will necessarily mar the performance of the pen.

In Rotating Compasses Nos. 1668 and 1669 the introduction of a two-spring arrangement eliminates this defect entirely, it forces the pen point to remain parallel to the center point; the angle to the drawing surface being constant, no matter what the size of the circle may be.

ALCO "CIRCLE A" DRAWING PENS



The Ruling Pens are made of the finest quality of steel. The material used in Pens Nos. 1600 to 1602 being made especially hard, they are unequaled for their extreme hardness and toughness.

Lateral motion of the blades is entirely overcome in the pens by T-bolt screws. The screws move freely and can adjust themselves to the position of the blades.

All Ruling Pens have metal handles.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

ALCO "CIRCLE A" DRAWING INSTRUMENTS

Each Instrument stamped Alco "Circle A."



No. 1600 No. 1601 No. 1602 No. 1601C No. 1604 No. 1608

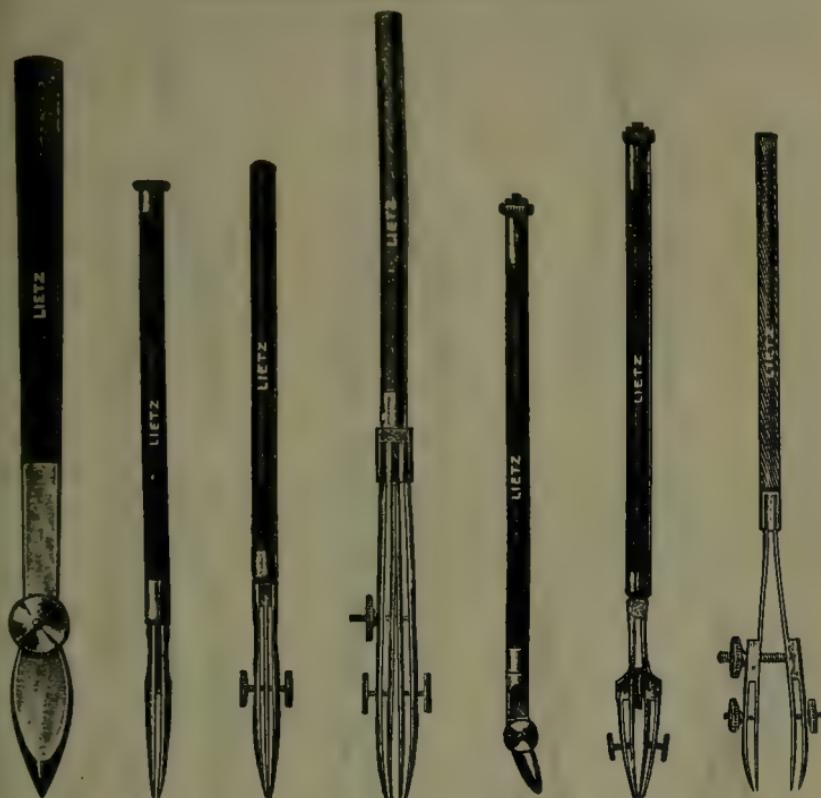
Each

- No. 1600.** Ruling Pen, $4\frac{1}{2}$ in., spring blade, aluminum handle, extra hard and tough material.....
No. 1601. Ruling Pen, 5 in., spring blade, aluminum handle, extra hard and tough material.....
No. 1602. Ruling Pen, $5\frac{1}{2}$ in., spring blade, aluminum handle, extra hard and tough material.....
No. 1600C. Ruling Pen, $4\frac{1}{2}$ in., with cross joint, aluminum handle....
No. 1601C. Ruling Pen, 5 in., with cross joint, aluminum handle....
No. 1602C. Ruling Pen, $5\frac{1}{2}$ in., with cross joint, aluminum handle....
The cross joint is a simple construction for rapidly opening and cleaning the pen. Maintains adjustment for width of lines without altering.
No. 1604. Ruling Pen, $5\frac{1}{2}$ in., with graduated thumbscrew, aluminum handle.....
The thumbscrews on Pens No. 1604 are divided into 20 divisions, each alternate one marked with figure. One whole turn equals 1 m/m of width of line. The best arrangement for readjusting to width of line after cleaning.
No. 1608. Ruling Pen, 5 in., for fine lines, aluminum handle.....
Pens No. 1608 are excellent for very fine line work. Easily sharpened by merely grinding the slant.

See price list in back of catalog.

ALCO "CIRCLE A" DRAWING INSTRUMENTS

Each Instrument stamped Alco "Circle A."



No. 1612A No. 1630 No. 1633 No. 1633D No. 1634 No. 1635 No. 1637

Each

No. 1611A. Swedish Ruling Pen, 5½ in., narrow spoon shape, aluminum handle

No. 1612A. Swedish Ruling Pen, 6 in., broad spoon shape, aluminum handle

No. 1633. Three-nib Ruling Pen, 5 in., for heavy lines

No. 1633D. Border Pen, 6 in., metal handle

To draw at one stroke either a very heavy line or two lines of equal or different thicknesses.

No. 1634. *Curve Pen, 4¾ in., metal handle

No. 1635. *Double Curve Pen, 5¼ in., metal handle

No. 1637. Railroad Pen, 5½ in., metal handle

*Pens Nos. 1634 and 1635 are fastened to a rod which swivels in the hollow handle and thus follows the smallest curve with precision. The rod may be locked by means of a nut at the upper end, and the instrument may be used as an ordinary drawing or railroad pen.

NOTE—For Catalog Nos. 1608 and 1612 to 1629 see pages 285 to 293.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

ALCO "CIRCLE A" DRAWING INSTRUMENTS

Each Instrument stamped Alco "Circle A"

ANNULEAR SPRING BOW INSTRUMENTS

The great advantage of instruments of this construction lies in the annular spring which keeps the shanks of the instruments always at the same tension, no matter how large or small the opening.



No. 1651



No. 1652



No. 1654

Each

No. 1651. Annular Spring Bow Divider, German silver handle, 3½ in.....

No. 1652. Annular Spring Bow Pen, adjustable needle point, German silver handle, 3½ in.....

No. 1654. Annular Spring Bow Pencil, German silver handle, 3½ in.....

No. 1654C. Set of three Annular Spring Bow Instruments, Nos. 1651, 1652 and 1654, in Morocco case



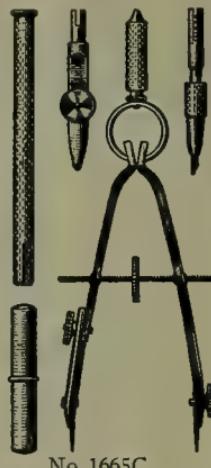
No. 1661



No. 1662



No. 1664



No. 1665C

Each

No. 1661. Annular Spring Bow Divider, German silver handle, 4¼ in.....

No. 1662. Annular Spring Bow Pen, German silver handle, 4¼ in.....

No. 1664. Annular Spring Bow Pencil, German silver handle, 4¼ in.....

No. 1664C. Set of three Annular Spring Bow Instruments, Nos. 1661, 1662 and 1664, in Morocco case

No. 1665C. Annular Spring Bow Instrument, 4¼ in., with pen and pencil points, lead box and metal handle holding four reserve needle points, in Morocco case

See price list in back of catalog.

ALCO "CIRCLE A" DRAWING INSTRUMENTS

Each instrument stamped Alco "Circle A."

ROTATING DROP BOW INSTRUMENTS

No. 1668



No. 1667



No. 1669

Each

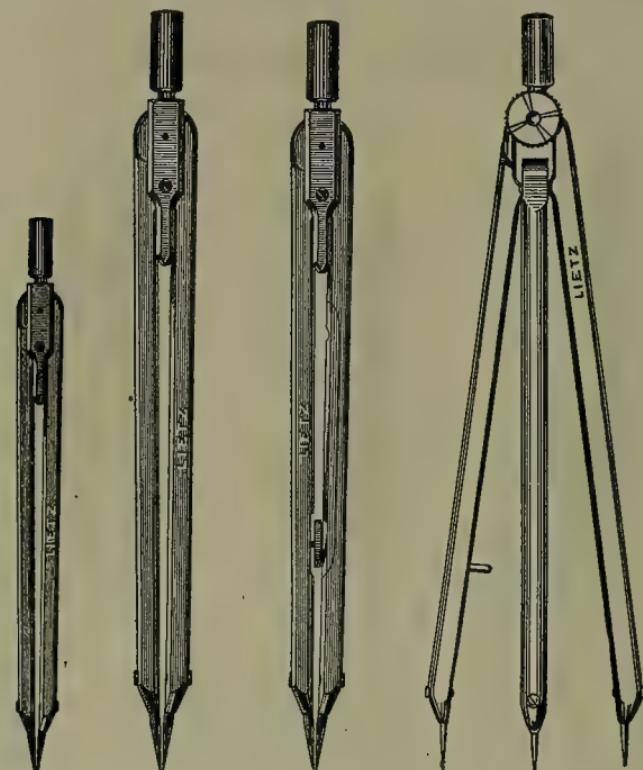
- No. 1666. Rotating Drop Bow Pen with single spring, 4½ in.....
No. 1666C. Same as No. 1666, in velvet-lined case.....
No. 1667. Rotating Drop Bow Instrument like No. 1666, but with
pencil part
No. 1667C. Same as No. 1667, in velvet-lined case.....
No. 1668. Rotating Drop Bow Pen with double spring, 4½ in.....
No. 1668C. Same as No. 1668, in velvet-lined case.....
No. 1669. Rotating Drop Bow Instrument like No. 1668, but with
pencil part
No. 1669C. Same as No. 1669, in velvet-lined case.....

Further description of the above instruments on page 275.

See price list in back of catalog.

ALCO "CIRCLE A" DRAWING INSTRUMENTS

Each instrument stamped Alco "Circle A."



No. 1680-1

No. 1680-2

No. 1681-2

No. 1680-3L

Each

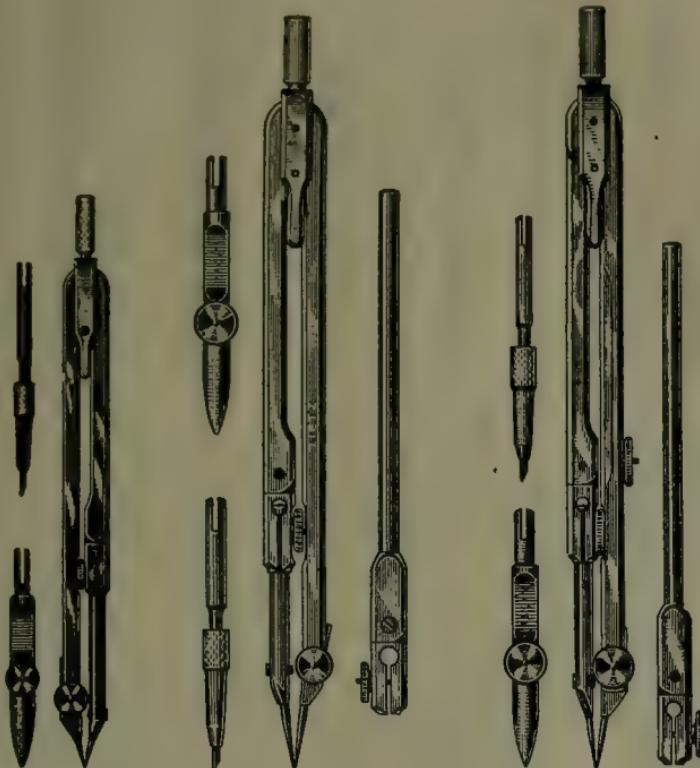
- No. 1680-1.** Plain Dividers, 4 in., with replaceable steel points.....
No. 1680-2. Plain Dividers, 6 in., with replaceable steel points.....
No. 1681-1. Hairspring Dividers, 4 in., with replaceable steel points..
No. 1681-2. Hairspring Dividers, 6 in., with replaceable steel points..
No. 1680-3L. Three-legged Dividers with replaceable steel points, for transferring to scale, 5 $\frac{3}{4}$ in.....

All Dividers equipped with straightening device.

See price list in back of catalog.

ALCO "CIRCLE A" DRAWING INSTRUMENTS

Each instrument stamped Alco "Circle A."



No. 1682N

No. 1684

No. 1684H

Each

No. 1682N. Compass, 4 in. with replaceable needle points, divider, pen and pencil parts.....

No. 1682NL. Same as No. 1682N, with lengthening bar.....

No. 1683N. Same as No. 1682N, but 5 in.....

No. 1683NL. Same as No. 1683N, with lengthening bar.....

No. 1684. Compass, 6 in., with replaceable needle points, divider, pen and pencil parts and lengthening bar.....

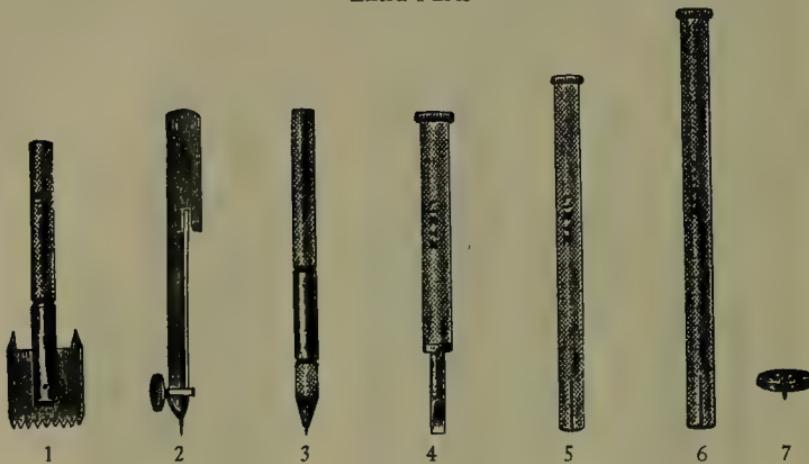
No. 1684H. Same as No. 1684, but with hairspring.....

All Compasses equipped with straightening device.

See price list in back of catalog.

ALCO "CIRCLE A" DRAWING INSTRUMENTS

Extra Parts



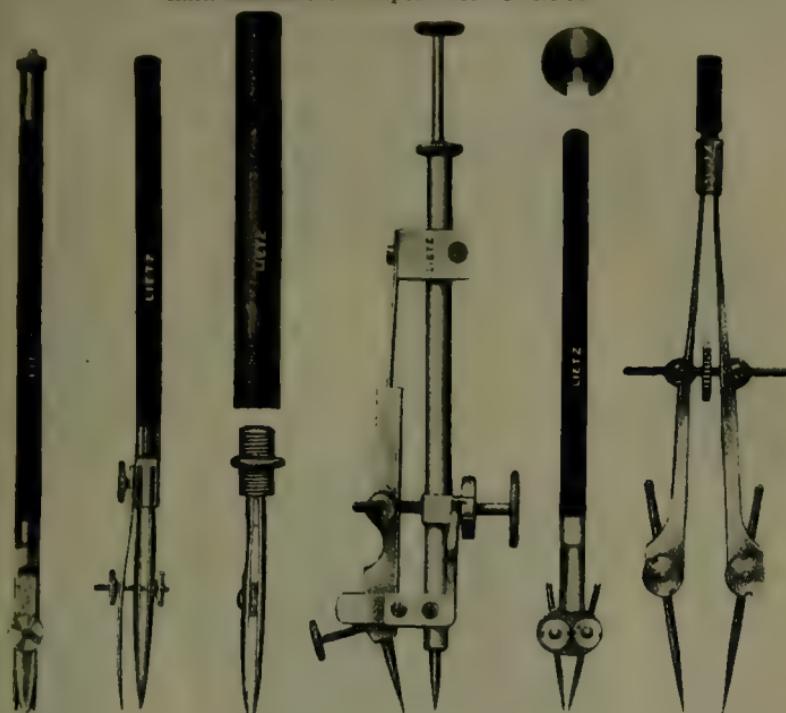
No. 1685

- No. 1685.**
- Part No.** 1 Measure Marker, for marking centimeters and millimeters.....
2 Pricker, $2\frac{3}{8}$ in., flat, to prevent rolling off the drawing board.....
3 Pricker, $2\frac{3}{8}$ in. The needle held by a small clutch can be readily exchanged. Any sewing needle will fit.....
4 Combination Key and Leadbox5 Metal Handle, $2\frac{1}{2}$ in., holding four needle points.....
6 Metal Handle, 3 in., holding four needle points.....
These handles fit the pen, pencil and needle parts of Compasses, any one of which can, in connection with the handle, be used as a separate instrument.
7 Center Tack, avoids the disagreeable enlarging of centers in paper..
8 Aluminum Handles for Ruling Pens.....
11 German silver Handle for Bow Instruments13 Screws or bolt and nut for pens.....
14 Bolts for side motion bow instruments.....
15 Center Motion Screw with left and right thread.....
16 Divider or needle point part for Nos. 1665C-1669, etc.....
18 Pen part for Nos. 1665C-1669, etc.....
19 Pencil part for Nos. 1665C-1669, etc.....
20 Divider or needle point part for No. 1682, etc.....
21 Pencil part for No. 1682, etc.....
22 Pen part for No. 1682, etc.....
23 Divider or needle point part for No. 1684, etc.....
24 Pencil part for No. 1684, etc.....
25 Pen part for No. 1684, etc.....
26 Lengthening Bar for 4 in. Compasses.....
27 Lengthening Bar for 6 in. Compasses.....
For Needle Points, extra boxes of Leads, Horn Centers, etc., see bottom of page 262.

See price list in back of catalog.

ALCO "CIRCLE A" DRAWING INSTRUMENTS

Each instrument stamped Alco "Circle A."



No. 1690

No. 1691

No. 1692

No. 1693

No. 1694

No. 1695

Each

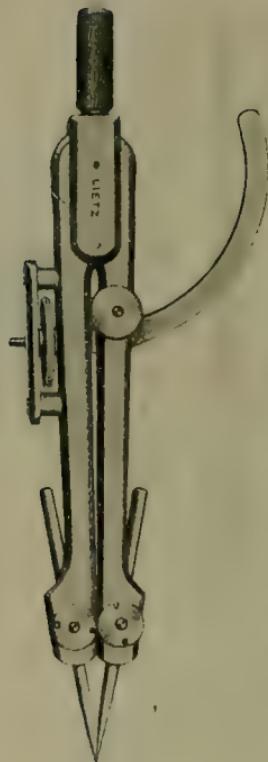
- No. 1690. Spline Pen, $4\frac{3}{4}$ in.
Used in conjunction with splines, ship curves, adjustable curves, etc.
A small blade fastened to the pen serves as a guide to follow curve.
- No. 1691. Cross Hatching Pen, 5 in., aluminum handle.
This pen is fitted with an adjustable third blade as guide for maintaining a uniform distance of lines in cross-hatching and is worked in this way that the point of this blade, after being adjusted to the desired distance, is run along the previously drawn line.
- No. 1692. Pocket Pen, 5 in., aluminum tube serving either as handle or protecting sheath.
- No. 1693. Rotating Compasses, $4\frac{1}{4}$ in., with etching needle and graduated screw, in morocco case.
It is advisable to use both hands in using this compass. Hold head of center pin with forefinger of right hand and effect rotation with left.
- No. 1694. Double Tracer, 5 in., spanning $9\frac{1}{16}$ in.
- No. 1695-1. Spring Dividers with etching needle, spanning $1\frac{1}{2}$ in.
- No. 1695-2. Spring Dividers with adjustable steel points, spanning 3 in.
- No. 1695-3. Spring Dividers with adjustable steel points, spanning 6 in.
Spring Dividers of the ordinary construction require considerable time in adjusting. This drawback is overcome in our instruments Nos. 1695-1 to 1695-8 by an adjusting screw with notches at equal distances, by means of which they can at once be set for approximately the distance required, the final adjustment only being effected by the regulating screw.

See price list in back of catalog.

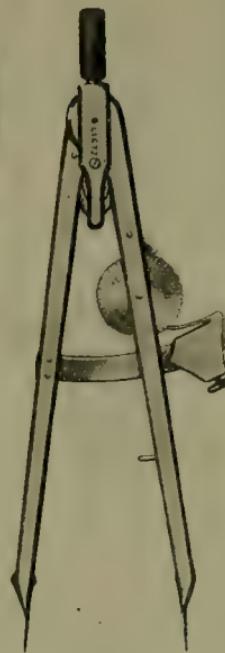
ALCO "CIRCLE A" DRAWING INSTRUMENTS

Each instrument stamped Alco "Circle A."

INSTRUMENTS FOR LITHOGRAPHERS



Nos. 1696-1697



No. 1698



No. 1699

Each

- No. 1696.** Lithographers' Etching Compass, $5\frac{3}{4}$ in., very strong, with arc and micrometer adjustment. In morocco case.....
No. 1696ED. Same as No. 1696, but with etching diamond.....
No. 1697. Lithographers' Etching Compass, like No. 1696, but $8\frac{1}{4}$ in. In morocco case.....
No. 1697ED. Same as No. 1697, but with etching diamond.....
No. 1698. Lithographers' Dividers, $5\frac{3}{4}$ in., with arc and recording wheel
- No. 1699.** Lithographers' Compass, 6 in., with arc and automatic clamping device, divider, pen and pencil parts.....

Nos. 1698 and 1699 are equipped with straightening device.

See price list in back of catalog.

ALCO "CIRCLE A" DRAWING INSTRUMENTS**In Fine Morocco Cases**

Each instrument stamped Alco "Circle A."



No. 1608PB

No. 1608PB. Pocket Book Case, velvet-lined, containing:

- | | |
|---|------------------|
| No. 1682N. Compasses, 4 in., with replaceable needle points,
divider, pen and pencil parts..... | |
| No. 1685-4. Combination Key and Leadbox..... | ..... |
| No. 1685-5. Metal Handle with four needle points..... | ..... |
| Per Set..... | Code Word, MOCHA |



No. 1612PB

No. 1612PB. Pocket Book Case, velvet-lined, containing::

- | | |
|---|------------------|
| No. 1601. Ruling Pen, 5 in..... | ..... |
| No. 1652. Annular Bow Pen, 3½ in..... | ..... |
| No. 1684. Compass, 6 in., with replaceable needle points, di-
vider, pen and pencil parts, and lengthening bar..... | |
| No. 1685-4. Combination Key and Leadbox..... | ..... |
| No. 1685-6. Metal Handle with four needle points..... | ..... |
| No. 1685-7. Center Tack ..... | ..... |
| Per set | Code Word, MODAL |

Dividers and Compasses equipped with straightening device.

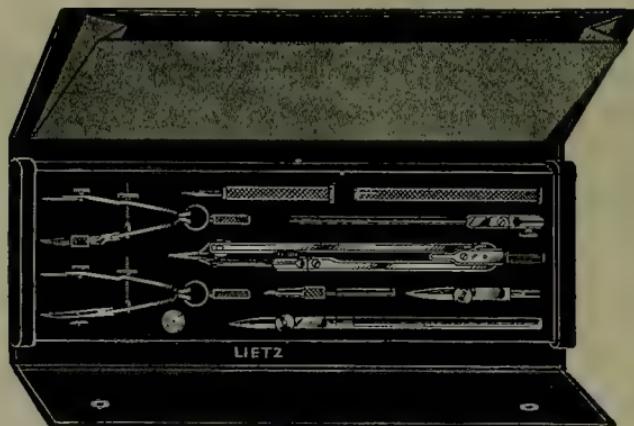
See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

ALCO "CIRCLE A" DRAWING INSTRUMENTS

In Fine Morocco Cases

Each instrument stamped Alco "Circle A."



No. 1613PB

No. 1613PB. Pocket Book Case, velvet-lined, containing:

No. 1601.	Ruling Pen, 5 in.....
No. 1652.	Annular Spring Bow Pen, 3½ in.....
No. 1654.	Annular Spring Bow Pencil, 3½ in.....
No. 1684.	Compass, 6 in., with replaceable needle points, divider, pen and pencil parts, lengthening bar.....
No. 1685-4.	Combination Key and Leadbox.....
No. 1685-6.	Metal Handle with four needle points.....
No. 1685-7.	Center Tack Per set Code Word, MOHAIR.

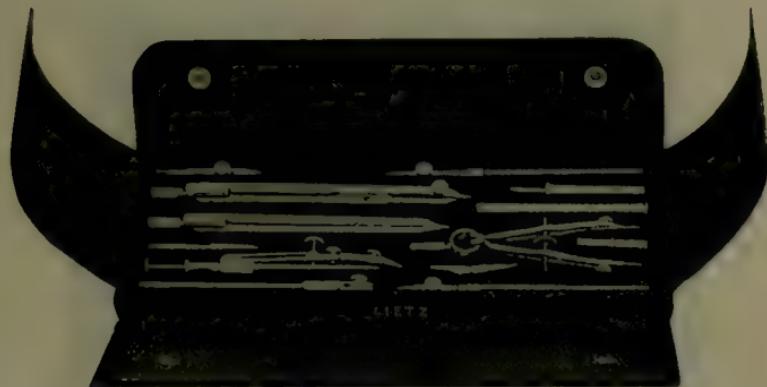
Dividers and Compasses equipped with straightening device.

See price list in back of catalog.

ALCO "CIRCLE A" DRAWING INSTRUMENTS

In Fine Morocco Cases

Each instrument stamped Alco "Circle A."



No. 1621PB

No. 1621PB. Pocket Book Case, velvet-lined, containing:

No. 1600.	Ruling Pen, 4½ in.....	
No. 1601.	Ruling Pen, 5 in.....	
No. 1661.	Steel Spring Bow Divider, 4¼ in.....	
No. 1669.	Rotating Drop Bow Pen, 4½ in., with pencil point	
No. 1681-2.	Hairspring Divider, 5¾ in., with replaceable steel points	
No. 1684.	Compass, 6 in., with replaceable needle points, divider, pen and pencil parts, lengthening bar.....	
No. 1685-4.	Combination Key and Leadbox	
No. 1685-6.	Metal Handle, 3 in., with four needle points for parts of No. 1684	
No. 1685-7.	Center Tack Per set	Code Word, MOIRE

No. 1621PBH. Same as No. 1621PB, but with Hairspring Compass
No. 1684H in lieu of No. 1684. Per set.....Code Word, **MOLAR**
Dividers and Compasses equipped with straightening device.

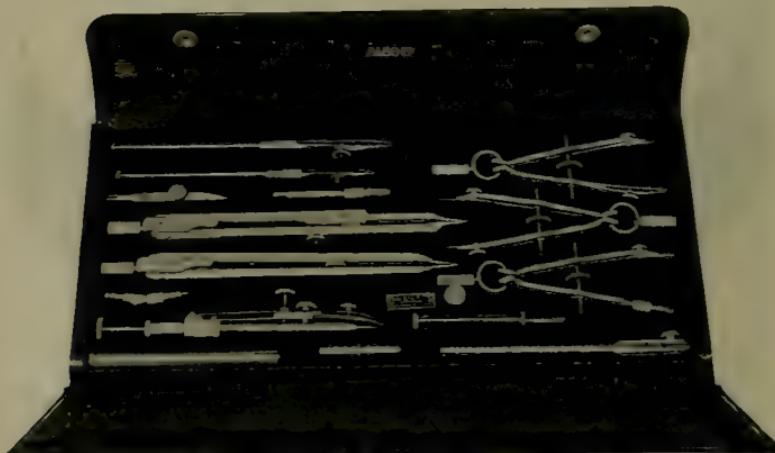
See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

ALCO "CIRCLE A" DRAWING INSTRUMENTS

In Fine Morocco Cases

Each instrument stamped "Alco Circle A."



No. 1623PBH

No. 1623PBH. Pocket Book Case, velvet lined, containing:

No. 1600.	Ruling Pen, 4½ in.
No. 1601.	Ruling Pen, 5 in.
No. 1661.	Annular Spring Bow Divider, 4¼ in.
No. 1662.	Annular Spring Bow Pen, 4¾ in.
No. 1664.	Annular Spring Bow Pencil, 4¼ in.
No. 1669.	Rotating Drop Bow Instrument with double spring, 4½ in.
No. 1681-2.	Hairspring Divider, 5¾ in.
No. 1684H.	Hairspring Compass, 6 in., with replaceable needle points, divider, pen and pencil parts, lengthening bar and straightening device.
No. 1685-4.	Combination Key and Lead Box.
No. 1685-6.	Metal Handle with four needle points.
No. 1685-7.	Center Tack.

Per set Code Word, **MOLDER**

Dividers and Compasses equipped with straightening device.

See price list in back of catalog.

ALCO "CIRCLE A" DRAWING INSTRUMENTS

In Fine Morocco Cases

Each instrument stamped Alco "Circle A."



No. 1624PBH

No. 1624PB. Pocket Book Case, velvet lined, containing:

No. 1600.	Ruling Pen, 4½ in.....
No. 1601.	Ruling Pen, 5 in.....
No. 1651.	Annular Spring Bow Divider, 3½ in.....
No. 1652.	Annular Spring Bow Pen, 3½ in.....
No. 1654.	Annular Spring Bow Pencil, 3½ in.....
No. 1681-2.	Hairspring Divider, 5¾ in., with replaceable steel points
No. 1684.	Compass, 6 in., with replaceable needle points, divider, pen and pencil parts, lengthening bar and straightening device
No. 1685-4.	Combination Key and Leadbox
No. 1685-6.	Metal Handle, with four needle points
No. 1685-7.	Center Tack
Per set	Code Word, MONAD

Code Word

No. 1624PBH. Same as No. 1624PB, but with Hairspring Compass No. 1684H in lieu of No. 1684. Per set..... **MONARCH****No. 1625PB.** Same as No. 1624PB, but with *center wheel* Bow Instruments Nos. 1661, 1662 and 1664 in lieu of Nos. 1651, 1652 and 1654. Per set **MONDAINE****No. 1625PBH.** Same as No. 1625PB, but with Hairspring Compass No. 1684H in lieu of No. 1684. Per set..... **MONGOOS** Dividers and Compasses equipped with straightening device.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

ALCO "CIRCLE A" DRAWING INSTRUMENTS

In Fine Morocco Cases

Each instrument stamped Alco "Circle A."



No. 1626PBH

No. 1626PB. Pocket Book Case, velvet lined, containing:

No. 1600.	Ruling Pen, 4½ in.....
No. 1612A.	Swedish Pen, 6 in.....
No. 1661.	Annular Spring Bow Divider, 4¾ in.....
No. 1662.	Annular Spring Bow Pen, 4¼ in.....
No. 1664.	Annular Spring Bow Pencil, 4¼ in.....
No. 1681-2.	Hairspring Divider, 5¾ in., with replaceable steel points
No. 1684.	Compass, 6 in., with replaceable needle points, divider, pen and pencil parts, lengthening bar....
No. 1685-4.	Combination Key and Leadbox.....
No. 1685-6.	Metal Handle, with four needle points, for parts of 1684
No. 1685-7.	Center Tack

Code Word

Per set **MONITOR**

No. 1626PBH. Same as No. 1626PB, but with Hairspring Compass No. 1684H in lieu of No. 1684. Per set..... **MONITRESS**

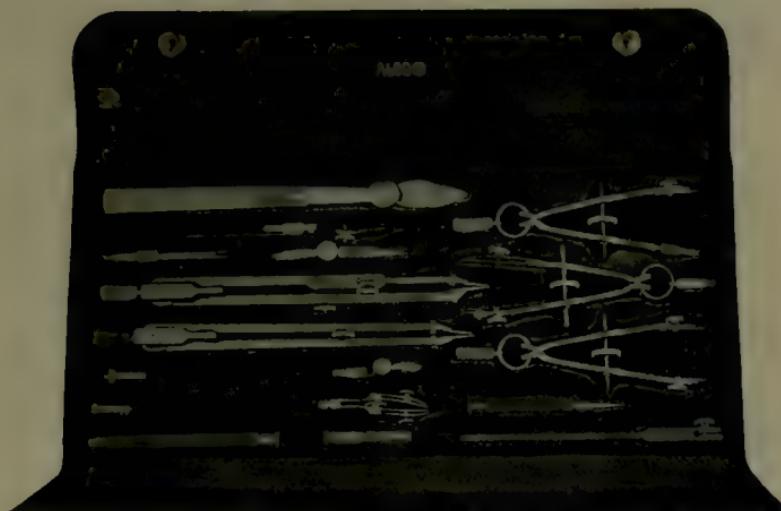
Dividers and Compasses equipped with straightening device.

See price list in back of catalog.

ALCO "CIRCLE A" DRAWING INSTRUMENTS

In Fine Morocco Cases

Each instrument stamped Alco "Circle A."



No. 1627PBH

No. 1627PBH. Pocket Book Case, velvet lined, containing:

No. 1600.	Ruling Pen, 4½ in.....
No. 1612A.	Swedish Pen, 6 in.....
No. 1661.	Annular Spring Bow Divider, 4¼ in.....
No. 1662.	Annular Spring Bow Pen, 4¾ in.....
No. 1664.	Annular Spring Bow Pencil, 4¼ in.....
No. 1681-2.	Hairspring Divider, 5¾ in., with replaceable steel points.....
No. 1684H.	Hairspring Compass, 6 in., with replaceable needle points, divider, pen and pencil parts, lengthening bar Curve Pen
No. 1634.	Double Curve Pen
No. 1685-4.	Combination Key and Leadbox.....
No. 1685-6.	Metal Handle, with four needle points, for parts of 1684
No. 1685-7.	Center Tack
	Per Set Code Word, MONOLITH .

Dividers and Compasses equipped with straightening device.

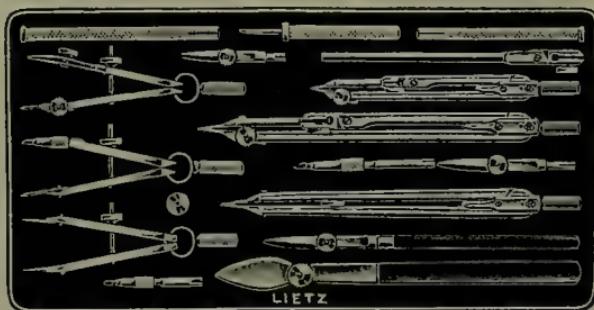
See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

ALCO "CIRCLE A" DRAWING INSTRUMENTS

In Fine Morocco Cases

Each instrument stamped Alco "Circle A."



No. 1628PB

No. 1628PB. Pocket Book Case, velvet lined, containing:

No. 1601.	Ruling Pen, 5 in.
No. 1612A.	Swedish Ruling Pen, 6 in.
No. 1651.	Annular Spring Bow Divider, 3½ in.
No. 1652.	Annular Spring Bow Pen, 3½ in.
No. 1654.	Annular Spring Bow Pencil, 3½ in.
No. 1681-2.	Hairspring Divider, 5¾ in.
No. 1682N.	Compass, 4 in., with divider, pen and pencil parts
No. 1684.	Compass, 6 in., with divider, pen and pencil parts
No. 1685-4.	Combination Key and Leadbox
No. 1685-5.	Metal Handle with four needle points, for parts of No. 1682N
No. 1685-6.	Metal Handle with four needle points, for parts of No. 1684
	Per set Code Word, MONORAIL

No. 1628PBH. Same as No. 1628PB, but with Hairspring Compass No. 1684H in lieu of No. 1684. Per set....Code Word, **MONOTYPE** Dividers and Compasses equipped with straightening device.

See price list in back of catalog.

ALCO "CIRCLE A" DRAWING INSTRUMENTS

In Polished Black Walnut Case

Each Instrument stamped Alco "Circle A."



No. 1629

No. 1629. Polished Black Walnut Case with lock, velvet lined, containing:

No. 1600.	Ruling Pen, 4½ in.
No. 1601.	Ruling Pen, 5 in.
No. 1602.	Ruling Pen, 5½ in.
	Dotting Instrument
	Dotting Instrument, for beam compass
No. 1661.	Annular Spring Bow Divider, 4¼ in.
No. 1662.	Annular Spring Bow Pen, 4¼ in.
No. 1664.	Annular Spring Bow Pencil, 4¼ in.
No. 1669.	Rotating Drop Bow Pen with pencil part, 4¼ in.
No. 1681-2.	Hairspring Divider, 5¾ in.
No. 1684H.	Hairspring Compass, 6 in., with pen, divider, and pencil parts, lengthening bar
	Beam Compass, with wooden bar
No. 1685-3.	Pricking Point
No. 1685-4.	Combination Key and Leadbox
No. 1685-5.	Metal Handle
No. 1685-6.	Metal Handle
No. 1685-7.	Three Center Tacks
	Per set Code Word, MONOXIDE

Dividers and Compasses equipped with straightening device.

NOTE—For Catalog Numbers 1630 to 1699 see pages 277 to 284.

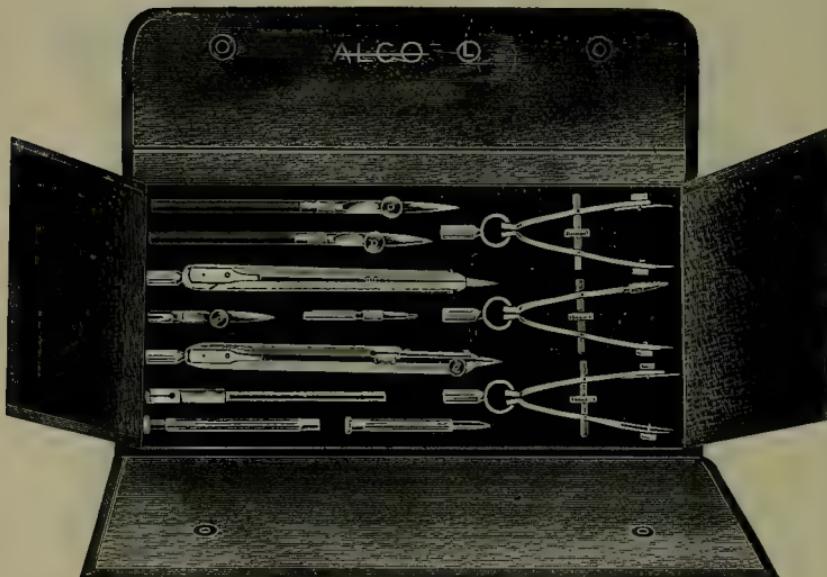
See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

ALCO "CIRCLE L" DRAWING INSTRUMENTS

In Fine Morocco Cases

Each instrument stamped **ALCO** © or the A. Lietz Co.



No. 1725PBG

An excellent set of high-grade instruments similar in design to the Alco "Circle A" line. Made of the best material and workmanship. Parts interchangeable. A very popular university and high school set.

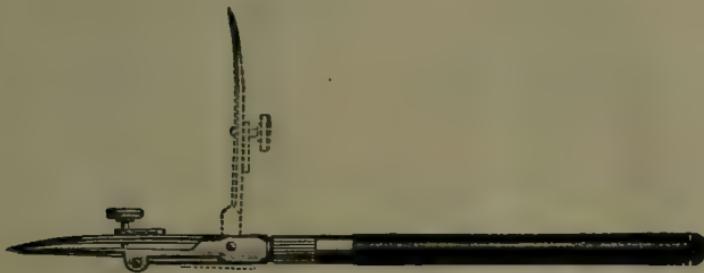
No. 1725PBG: Pocket Book Case, velvet lined, containing:

- Ruling Pen, 5 in.
- Ruling Pen, 5½ in.
- New Annular Spring Bow Divider, 4¼ in.
- New Annular Spring Bow Pen, 4¼ in.
- New Annular Spring Bow Pencil, 4¾ in.
- New Hairspring Divider, 6 in.
- New Compass, 6 in., with replaceable needle points, divider, pen and pencil parts, lengthening bar.
- Combination Key and Leadbox.
- Metal Handle with four needle points.
- Center Tack.
- All Dividers and Compasses equipped with straightening device.

Code Word, **MOORSTONE**

See price list in back of catalog.

ALCO SUPERIOR DRAWING INSTRUMENTS



- | | | |
|-------------|--------------------------------------|------|
| No. 1700SH. | Spring Hinge Ruling Pen, 4½ in | Each |
| No. 1701SH. | Spring Hinge Ruling Pen, 5 in. | |
| No. 1702SH. | Spring Hinge Ruling Pen, 5½ in. | |



No. 1784P



DOTTING INSTRUMENT

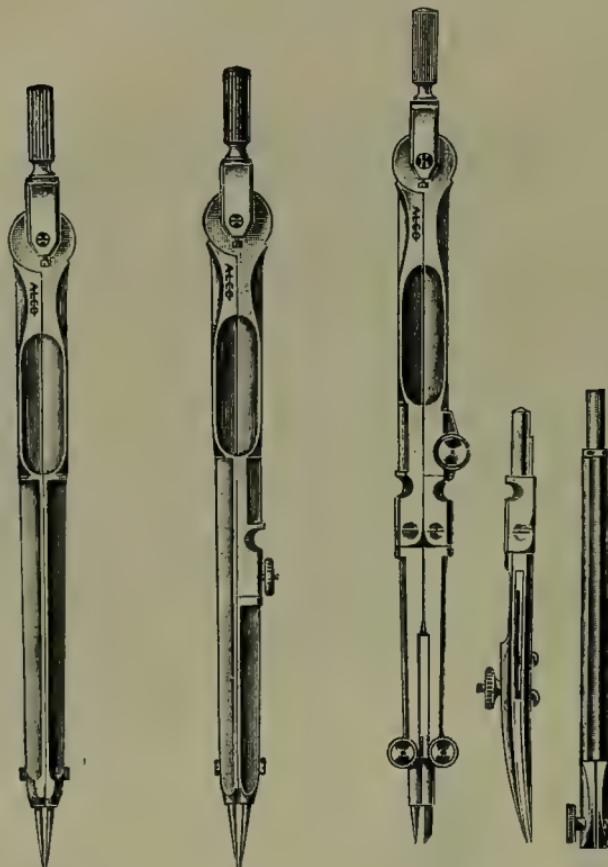
- No. 1723. Dotting Instrument for fitting to
compass or beam compass. Each
When ordering state number of compass
this is to fit.

POCKET COMPASS

- No. 1784P. Folding Pocket Compass, with
divider, pen and pencil points. Contained
in leather sheath. 3½" when folded. Each

See price list in back of catalog.

ALCO "SUPERIOR" DRAWING INSTRUMENTS



No. 1780-2

No. 1781

No. 1784

Each

No. 1780-2. Plain Dividers, 6 in., with replaceable steel points.....

No. 1781. Hairspring Dividers, 6 in., with replaceable steel points....

No. 1784. Compass, 6 in., with fixed needle point, pen and pencil parts and lengthening bar, slide catch pen.....

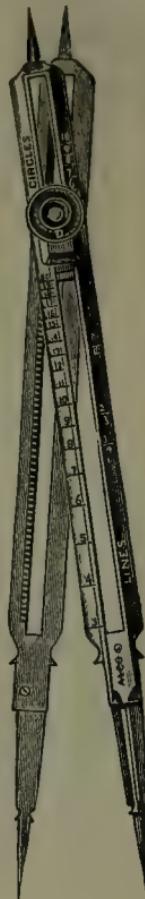
All Dividers and Compasses equipped with straightening device.

See price list in back of catalog.

ALCO SUPERIOR DRAWING INSTRUMENTS



No. 1790C



No. 1791C

Each

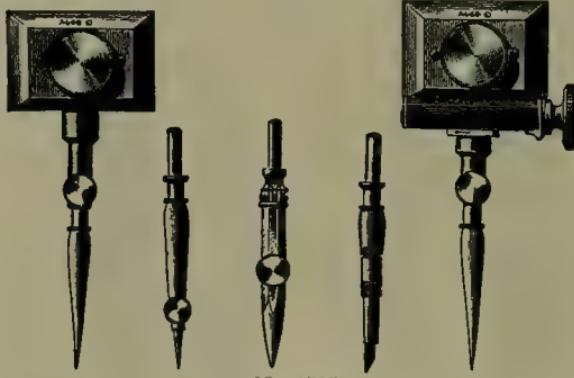
- No. 1790C. Proportional Divider, $7\frac{1}{4}$ in., for lines and circles, in velvet-lined case
- No. 1791C. Proportional Divider, $7\frac{1}{4}$ in., with rack movement, for lines, circles, planes and solids, in velvet-lined case.....
- No. 1792C. Proportional Divider, $9\frac{3}{4}$ in., with rack movement, for lines and circles, in velvet case.....
- No. 1790 $\frac{1}{2}$. Extra Cases, velvet lined, with bar lock for Proportional Dividers Nos. 1790-1792

For other Proportional Dividers see pages 263 and 318.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

ALCO SUPERIOR DRAWING INSTRUMENTS



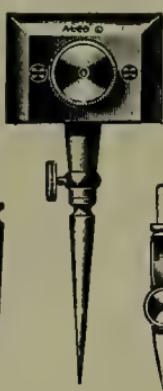
No. 1795

No. 1795. Beam Compass with two steel points, pen, pencil and
needle parts, lateral micrometer adjustment

No. 1795C. Same as No. 1795, in morocco velvet-lined case.....



No. 1796



No. 1797



No. 1796. Beam Compass, with two steel points, pen, pencil and
needle parts, vertical micrometer adjustment.....

No. 1796C. Same as No. 1796 in morocco velvet-lined case.....

No. 1797. Wheel Attachment or Balance for Beam Compasses Nos.
1795 and 1796

No. 1797C. Case only, velvet-lined, to contain Beam Compass No. 1795
and attachment No. 1797

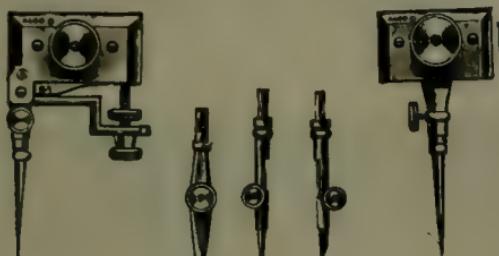
No. 1798C. Case only, velvet-lined, to contain Beam Compass No. 1796
and attachment No. 1797

For other Beam Compasses see pages 264 and 299.

For Beam Compass Bars (hardwood) see page 265.

See price list in back of catalog.

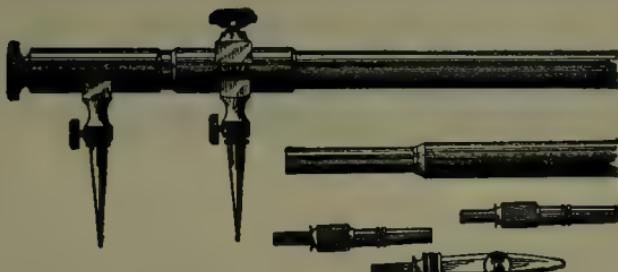
ALCO "SUPERIOR" DRAWING INSTRUMENTS



No. 1796½

No. 1796½. Minute Beam Compass with two steel points, pen, pencil and needle parts, vertical micrometer adjustment.....

No. 1796½C. Same as No. 1796½ in morocco velvet-lined case.....



No. 1800C

No. 1800C. Tubular Beam Compass, 18 in., 2 round German silver bars, with 2 steel points, pen, pencil and needle point, with micrometer adjustment, in morocco velvet-lined case.....

No. 1801C. Tubular Beam Compass, same as No. 1800C, but 24 in., and 3 round German silver bars and wheel attachment, in morocco velvet-lined case

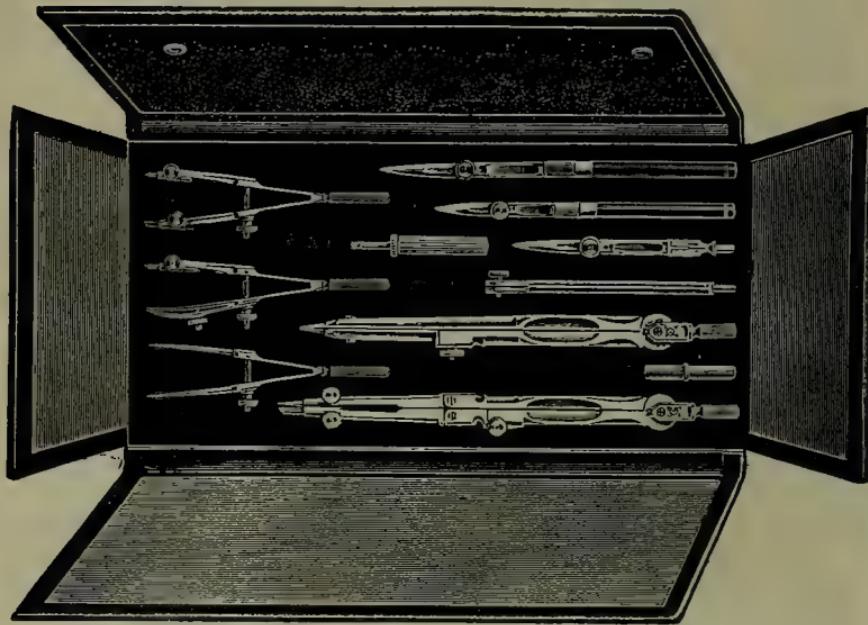
No. 1802C. Tubular Beam Compass, same as No. 1800C, but 36 in., and 3 round German silver bars and wheel attachment, in morocco velvet-lined case

No. 1800½. Cases Nos. 1800C, 1801C, and 1802C, including space for wheel attachment, extra

See price list in back of catalog.

ALCO "SUPERIOR" DRAWING INSTRUMENTS

In Fine Morocco Cases



No. 1824PBS

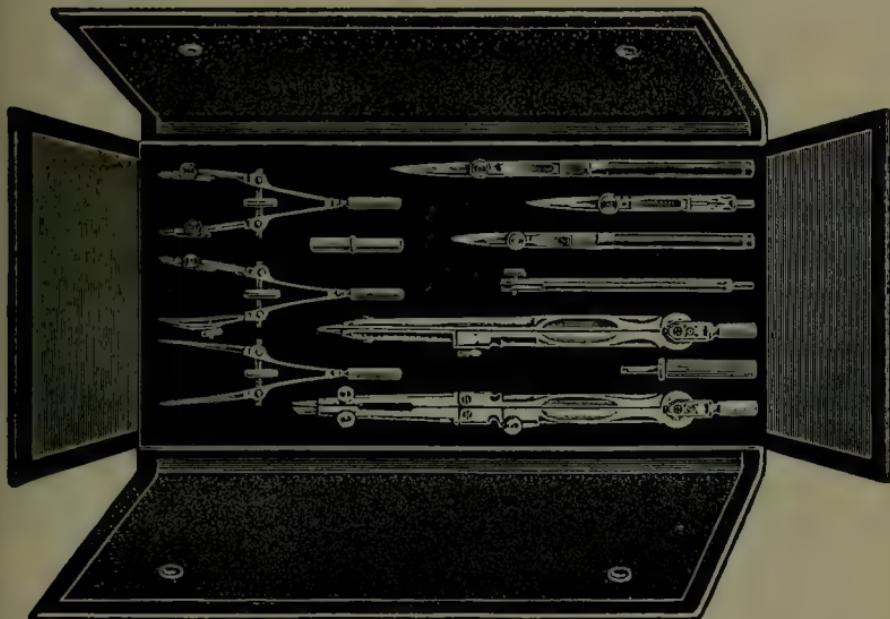
No. 1824PBS. Pocket Book Case, velvet lined, containing:

No. 1400SC.	Ruling Pen, 4½ in., with slide catch opening..
No. 1402SC.	Ruling Pen, 5½ in., with slide catch opening..
No. 1430S.	Steel Spring Bow Divider, 3½ in.....
No. 1432S.	Steel Spring Bow Pen, 3½ in.....
No. 1434S.	Steel Spring Bow Pencil, 3½ in.....
No. 1781.	Hairspring Divider, 6 in., steel points.....
No. 1784.	Compass, 6 in., with fixed needle point, pen and pencil parts and lengthening bar, pen with slide catch opening
No. 1985-4.	Combination Key and Leadbox
Per set	Code Word, NAILGUN
Dividers and Compasses equipped with straightening device.	

See price list in back of catalog.

ALCO "SUPERIOR" DRAWING INSTRUMENTS

In Fine Morocco Cases



No. 1825PBC

No. 1825PBC. Pocket Book Case, velvet lined, containing:

No. 1400SC.	Ruling Pen, 4½ in., with slide catch opening....
No. 1402SC.	Ruling Pen, 5½ in., with slide catch opening....
No. 1440C.	Bow Divider, center adjustment, 3½ in.....
No. 1442C.	Bow Pen, center adjustment, 3½ in.....
No. 1444C.	Bow Pencil, center adjustment, 3½ in.....
No. 1781.	Hairspring Divider, 6 in., steel points.....
No. 1784.	Compass, 6 in., with fixed needle point, pen and pencil parts and lengthening bar, pen with slide catch opening
No. 1985-4.	Combination Key and Leadbox.....
Per set	Code Word, NAINSOOK

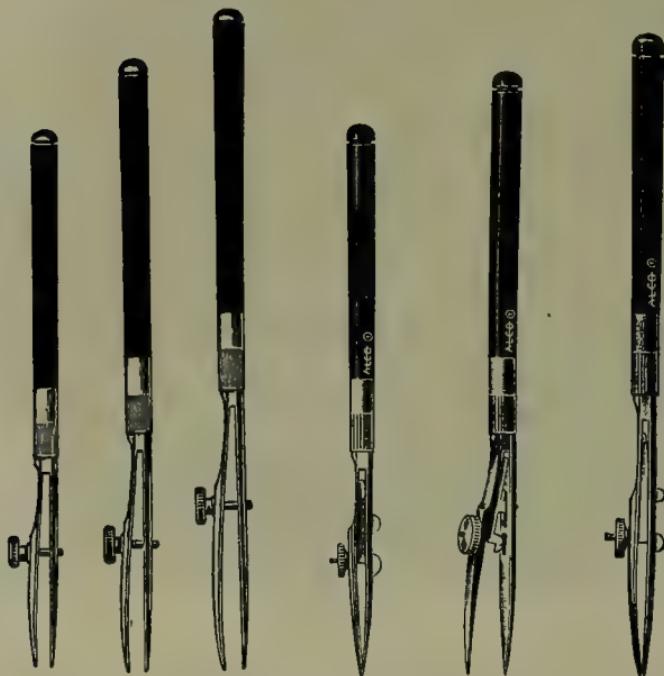
Dividers and Compasses equipped with straightening device.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

ALCO "CIRCLE T" DRAWING INSTRUMENTS

Each instrument stamped **ALCO** **®** or The A. Lietz Co.



No. 1840 No. 1841 No. 1842 No. 1840SC No. 1841SC No. 1842SC

Each

- No. 1840.** Ruling Pen, 4½ in., upper blade with spring, ebony handle
No. 1841. Ruling Pen, 5 in., upper blade with spring, ebony handle
No. 1842. Ruling Pen, 5½ in., upper blade with spring, ebony handle
No. 1840SC. Ruling Pen, 4½ in., slide catch opening, ebony handle....
No. 1841SC. Ruling Pen, 5 in., slide catch opening, ebony handle....
No. 1842SC. Ruling Pen, 5½ in., slide catch opening, ebony handle....

See price list in back of catalog.

ALCO "CIRCLE T" DRAWING INSTRUMENTS



No. 1850



No. 1852



No. 1854

Each

- No. 1850. Steel Spring Bow Divider, German silver handle, 3½ in.....
No. 1852. Steel Spring Bow Pen, German silver handle, 3½ in.....
No. 1854. Steel Spring Bow Pencil, German silver handle, 3½ in.....



No. 1860



No. 1862



No. 1864

Each

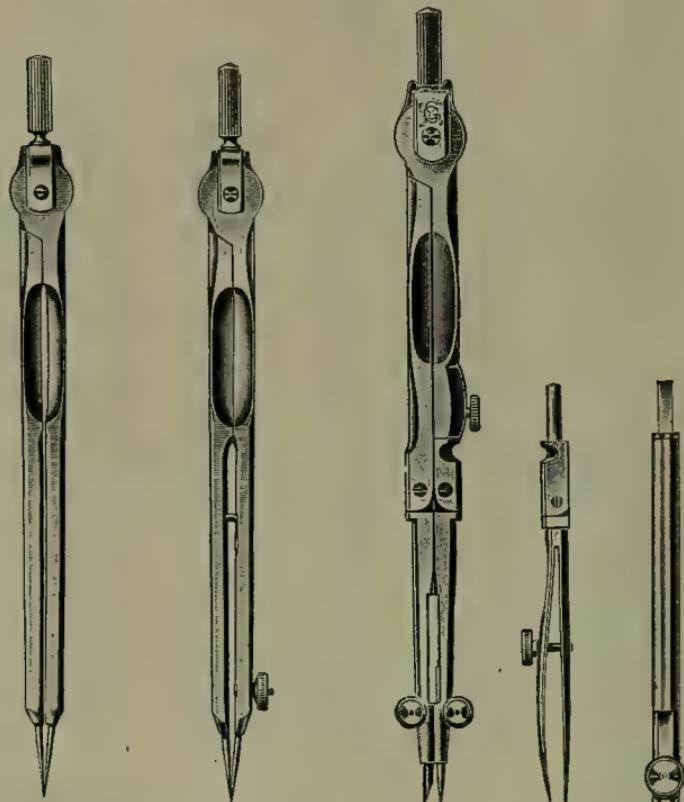
- No. 1860. Nickel-Silver circular Spring-Bow Divider 4¼ inches center wheel adjustment.....
No. 1862. Nickel-Silver circular Spring-Bow Pen 4¼ inches center wheel adjustment.....
No. 1864. Nickel-Silver circular Spring-Bow Pencil 4¼ inches center wheel adjustment.....

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

ALCO "CIRCLE T" DRAWING INSTRUMENTS

Each instrument stamped Alco "Circle T" or The A. Lietz Co.



No. 1880-2S

No. 1881S

No. 1884 $\frac{3}{4}$ S

Each

No. 1880-2S. Plain Divider, 6 in.....

No. 1881S. Hairspring Divider, 6 in.....

No. 1884 $\frac{3}{4}$ S. Compass, 6 in., with fixed needle point, pen and pencil parts and lengthening bar.....

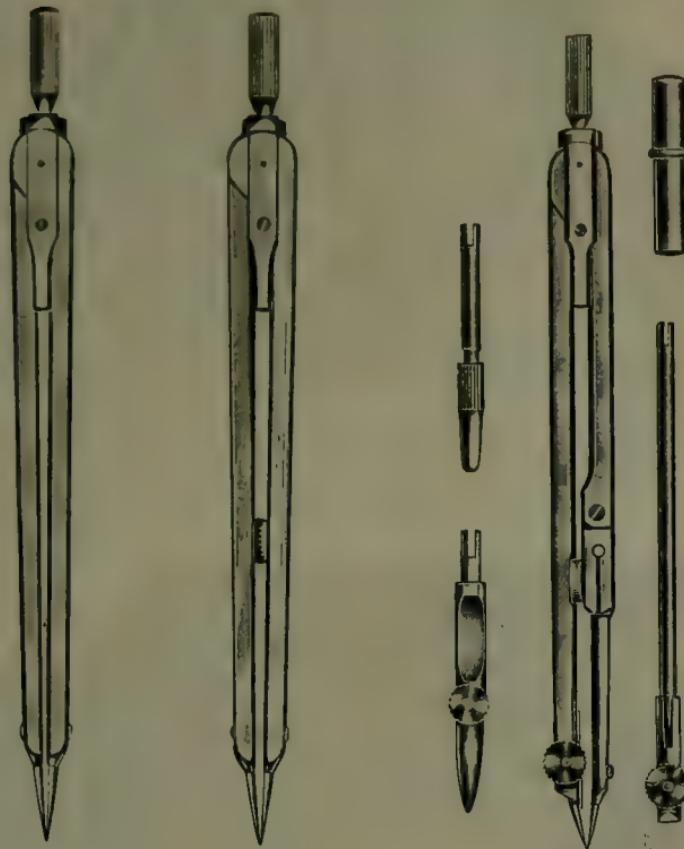
All Dividers and Compasses equipped with straightening device.

NOTE—For Catalog No. 1985, extra parts for ALCO "Circle T" Drawing Instruments, see page 323.

See price list in back of catalog.

ALCO "CIRCLE T" DRAWING INSTRUMENTS

Each instrument stamped Alco "Circle T" or The A. Lietz Co.



No. 1880-2R

No. 1881R

No. 1884 3/4R

Each

No. 1880-2R. Plain Divider, 6 in.**No. 1881R.** Hairspring Divider, 6 in.**No. 1884 3/4R.** Compass, 6 in., with reversible needle point, divider, pen and pencil parts and lengthening bar.....

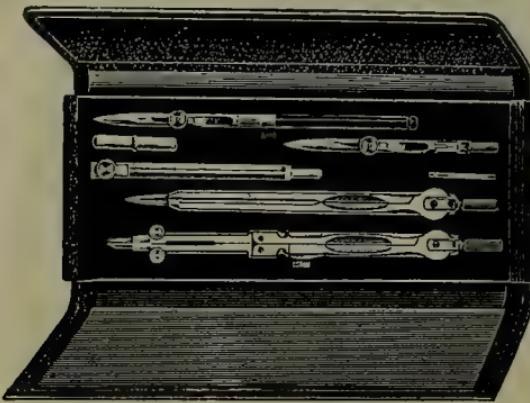
All Dividers and Compasses equipped with straightening device.

NOTE—For Catalog No. 1985, extra parts for ALCO "Circle T" Drawing Instruments, see page 323.

See price list in back of catalog.

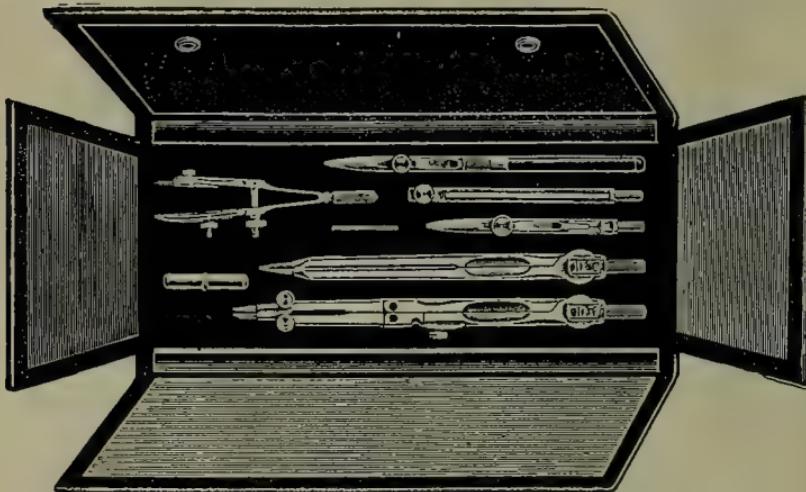
THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

ALCO "CIRCLE T" DRAWING INSTRUMENTS
In cases.



No. 1890PBS

No. 1890PBS. Pocket Book Case, velvet lined, containing:
No. 1842SC. Ruling Pen, 5½ in., slide catch opening.
No. 1880-2S. Plain Divider, 6 in.
No. 1884-¾ S. Compass, 6 in., with fixed needle point, pen and pencil
point and lengthening bar.
Box with Leads and Key.
Per set Code Word, OAKUM

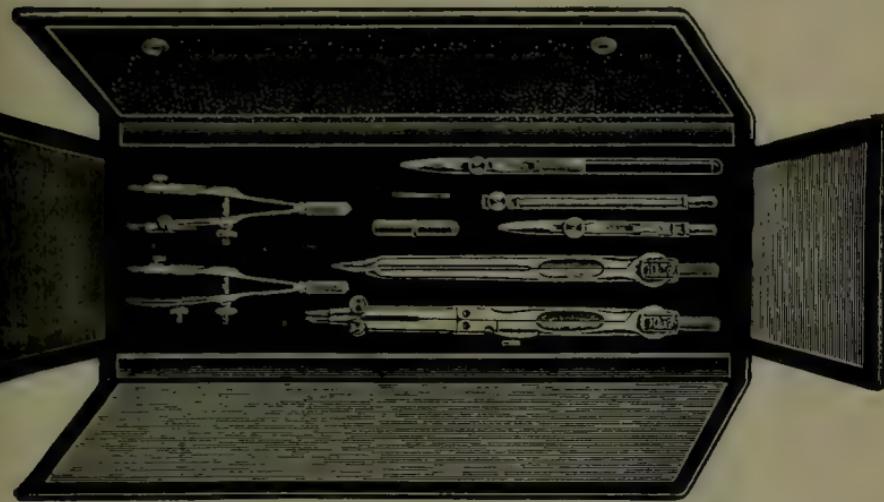


No. 1892PBS

No. 1892PBS. Same as No. 1890PBS, but with (in addition):
No. 1852. Steel Spring Bow Pen 3½ in.
Per set Code Word, OPAL
All Dividers and Compasses equipped with straightening device.

See price list in back of catalog.

ALCO "CIRCLE T" DRAWING INSTRUMENTS
In Cases



No. 1893PBS

No. 1893PBS. Pocket Book Case, velvet lined, containing:

No. 1842SC.	Ruling Pen, 5½ in., slide catch opening.....
No. 1852.	Steel Spring Bow Pen, 3½ in.
No. 1854.	Steel Spring Bow Pencil, 3½ in.
No. 1880-2S.	Plain Divider, 6 in.
No. 1884 3/4 S.	Compass, 6 in., with fixed needle point, pen and pencil parts and lengthening bar.....
	Box with Leads and Key.....
Per set	Code Word, OROIDE

No. 1893PBR. Same combination as No. 1893PBS, but with round style compass and divider and circular steel spring bows as follows:

No. 1842.	Ruling Pen, 5½ in.
No. 1912R.	Circular Steel Spring Bow Pen, 3½ in.
No. 1914R.	Circular Steel Spring Bow Pencil, 3½ in.
No. 1880-2R.	Plain Divider, 6 in.
No. 1884 3/4 R.	Compass, 6 in., with reversible needle point, di- vider, pen and pencil parts and lengthening bar.....
	Box with Leads and Key..... Code Word, ORPIN

All Dividers and Compasses equipped with straightening device.

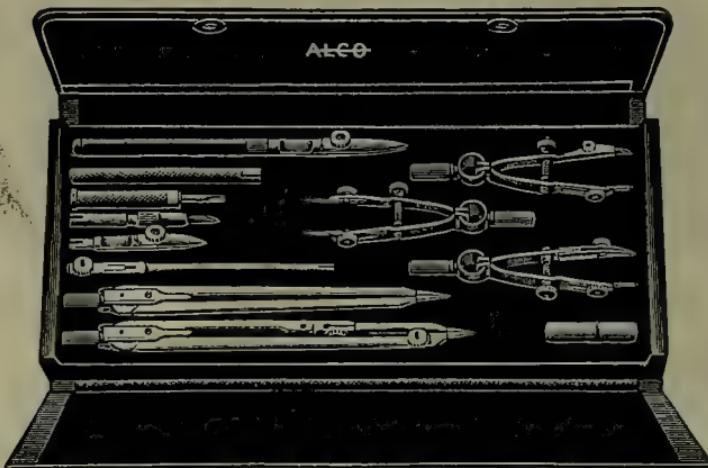
See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

ALCO "CIRCLE T" DRAWING INSTRUMENTS

In Cases

Each instrument Stamped **ALCO** ® or The A. Lietz Co.



No. 1893-3PBR

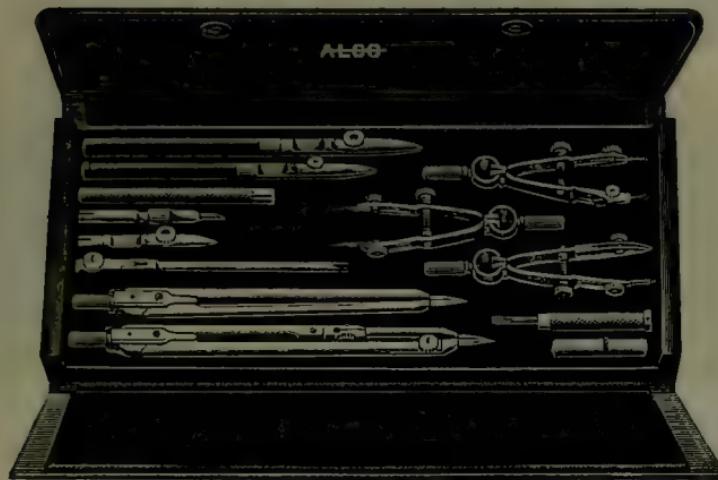
No. 1893-3PBR. Pocket Book Case, velvet lined, containing:

No. 1842.	Ruling Pen, 5½ in.
No. 1910R.	Circular Steel Spring Bow Divider, 3½ in.
No. 1912R.	Circular Steel Spring Bow Pen, 3½ in.
No. 1914R.	Circular Steel Spring Bow Pencil, 3½ in.
No. 1880-2R.	Plain Divider, 6 in.
No. 1884 ¾ R.	Compass, 6 in., with reversible needle point, divider, pen and pencil parts and lengthening bar.... Box with Leads and Key

Code Word, **ORRIS**

All Dividers and Compasses equipped with straightening device.

See price list in back of catalog.

ALCO "CIRCLE T" DRAWING INSTRUMENTS**In Cases**Each instrument stamped **ALCO**  or The A. Lietz Co.

No. 1894PBR

No. 1894PBR. Pocket Book Case, velvet lined, containing:

No. 1840.	Ruling Pen, 4½ in.....
No. 1842.	Ruling Pen, 5½ in.....
No. 1910R.	Circular Steel Spring Bow Divider, 3½ in.....
No. 1912R.	Circular Steel Spring Bow Pen, 3½ in.....
No. 1914R.	Circular Steel Spring Bow Pencil, 3½ in.....
No. 1881R.	Hairspring Divider, 6 in.....
No. 1884 ¾ R.	Compass, 6 in., with reversible needle point, divider, pen and pencil parts and lengthening bar.....
	Box with Leads and Key.....
	Per set .....Code Word, OSPREY

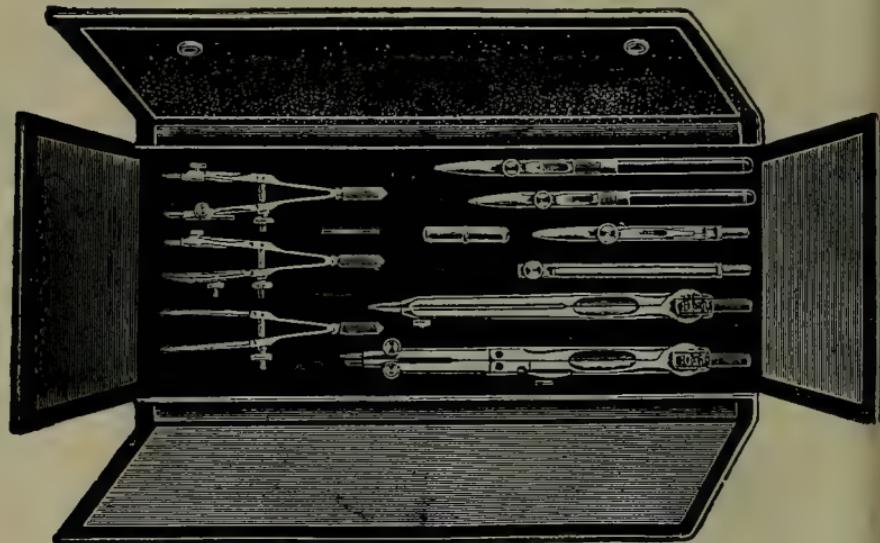
All Dividers and Compasses equipped with straightening device.

See price list in back of catalog.

ALCO "CIRCLE T" DRAWING INSTRUMENTS

In Cases

Each instrument stamped **ALCO**  or The A. Lietz Co.



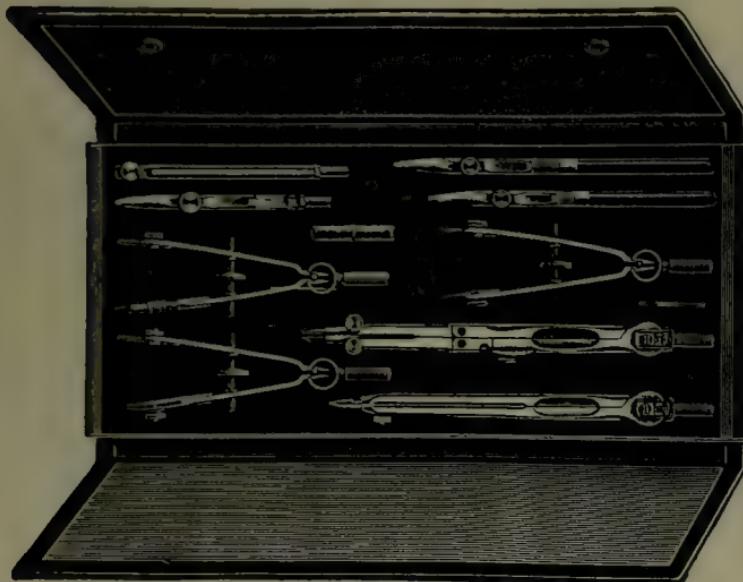
No. 1894PBS

No. 1894PBS. Pocket Book Case, velvet lined, containing:

No. 1840SC.	Ruling Pen, 4½ in., with slide catch.....
No. 1842SC.	Ruling Pen, 5½ in., with slide catch.....
No. 1850.	Steel Spring Bow Divider, 3½ in.....
No. 1852.	Steel Spring Bow Pen, 3½ in.....
No. 1854.	Steel Spring Bow Pencil, 3½ in.....
No. 1881.	Hairspring Divider, 6 in.....
No. 1884 ¾.	Compass, 6 in., with replaceable needle point, pen and pencil parts and lengthening bar.....
	Box with Leads and Key
	Per set Code Word, OXYGEN

All Dividers and Compasses equipped with straightening device.

See price list in back of catalog.

ALCO "CIRCLE T" DRAWING INSTRUMENTS**In Cases**Each instrument stamped **ALCO**  or The A. Lietz Co.

No. 1895PBN

No. 1895PBN. Pocket Book Case, velvet lined, containing:

- | | |
|--------------------|---|
| No. 1840SC. | Ruling Pen, 4½ in., with slide catch..... |
| No. 1842SC. | Ruling Pen, 5½ in., with slide catch..... |
| No. 1860. | New Annular Spring Bow Divider, 4¼ in..... |
| No. 1862. | New Annular Spring Bow Pen, 4¼ in..... |
| No. 1864. | New Annular Spring Bow Pencil, 4¼ in..... |
| No. 1881. | Hairspring Divider, 6 in..... |
| No. 1884 ¾. | Compass, 6 in., with replaceable needle point, pen
and pencil parts and lengthening bar..... |
| | Box with Leads and Key..... |
| | Code Word, OXYTONE |

All Dividers and Compasses equipped with straightening device.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

ALCO UNIVERSAL DRAWING INSTRUMENTS



No. 1900 , No. 1901 No. 1902 No. 1900C No. 1901C No. 1902C

		Each
No. 1900.	Ruling Pen, 4½ in., upper blade with spring, ebony handle	
No. 1901.	Ruling Pen, 5 in., upper blade with spring, ebony handle	
No. 1902.	Ruling Pen, 5½ in., upper blade with spring, ebony handle	
No. 1900C.	Ruling Pen, 4½ in., with release lever, ebony handle.....	
No. 1901C.	Ruling Pen, 5 in., with release lever, ebony handle.....	
No. 1902C.	Ruling Pen, 5½ in., with release lever, ebony handle.....	

See price list in back of catalog.

ALCO "UNIVERSAL" DRAWING INSTRUMENTS



No. 1910



No. 1912



No. 1914

Each

No. 1910. Steel Spring Bow Dividers, German silver handle, 3½ in...

No. 1912. Steel Spring Bow Pen, German silver handle, 3½ in.....

No. 1914. Steel Spring Bow Pencil, German silver handle, 3½ in....



No. 1910R



No. 1912R



No. 1914R



No. 1915R

Each

No. 1910R. Circular Steel Spring Bow Dividers, German silver handle, 3½ in...

No. 1912R. Circular Steel Spring Bow Pen, German silver handle, 3½ in.....

No. 1914R. Circular Steel Spring Bow Pencil, German silver handle, 3½ in....

No. 1915R. Circular Steel Spring Combination Bow Pen and Pencil, German silver handle, 3½ in....

See price list in back of catalog.

ALCO "UNIVERSAL" DRAWING INSTRUMENTS



No. 1930-2



No. 1931



No. 1934 $\frac{3}{4}$



No. 1930-2. Plain Divider, 6 in.

Each

No. 1931. Hairspring Divider, 6 in.

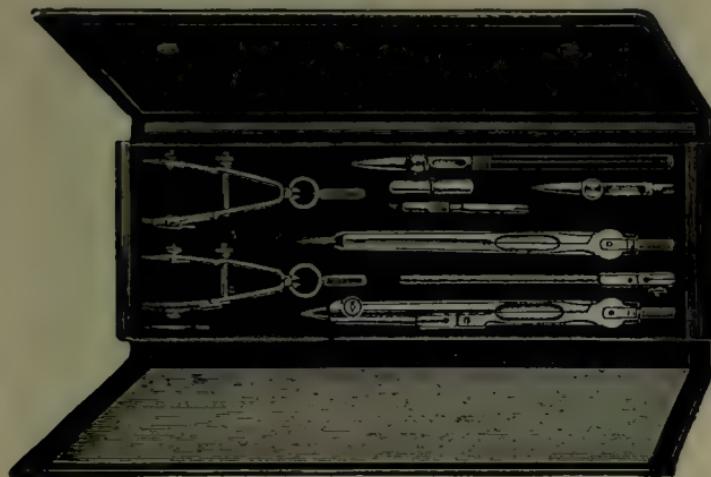
No. 1934 $\frac{3}{4}$. Compass, 6 in., with reversible needle point, divider, pen and pencil parts and lengthening bar....

All Dividers and Compasses equipped with straightening device.

See price list in back of catalog.

ALCO "UNIVERSAL" DRAWING INSTRUMENTS

In Cases



No. 1953PBR

No. 1953PBR. Pocket Book Case, velvet lined, containing:

No. 1902. Ruling Pen, 5½ in.

No. 1912R. Bow Pen, 3½ in., with ring spring.

No. 1914R. Bow Pencil, 3½ in., with ring spring.

No. 1930-2. Plain Divider, 6 in.

No. 1934 ¾. Compass, 6 in., with reversible needle point, divider, pen and pencil parts and lengthening bar.

Metal Handle for parts of Compass.

Key and Box of Leads.

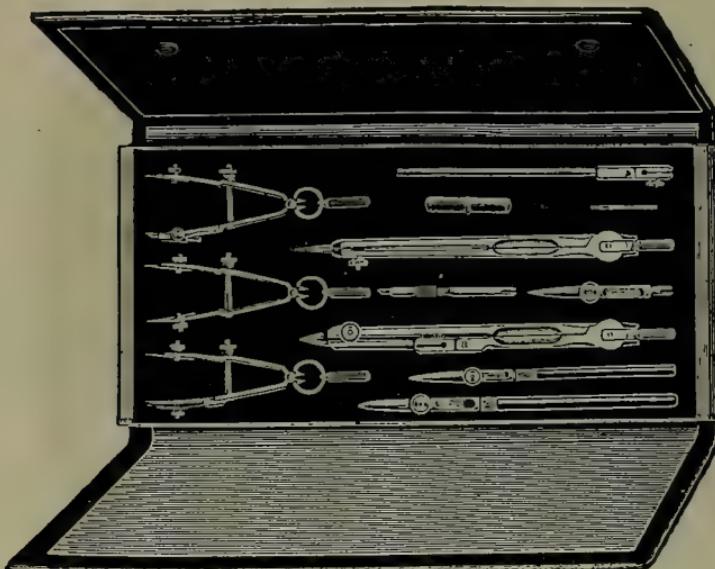
Per set Code Word, **PAGODA**

Compasses and Dividers equipped with straightening device.

See price list in back of catalog.

ALCO "UNIVERSAL" DRAWING INSTRUMENTS

In Cases



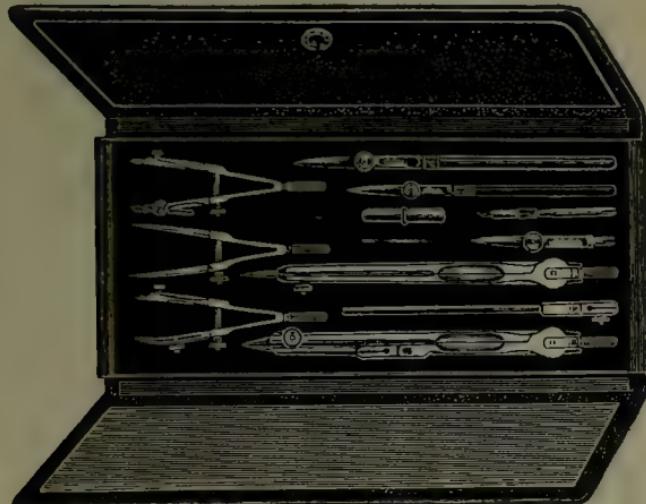
No. 1955PBR

No. 1955PBR. Pocket Book Case, velvet lined, containing:

- No. 1900.** Ruling Pen, 4½ in.
- No. 1902.** Ruling Pen, 5½ in.
- No. 1910R.** Bow Divider, 3½ in., with ring spring.
- No. 1912R.** Bow Pen, 3½ in., with ring spring.
- No. 1914R.** Bow Pencil, 3½ in., with ring spring.
- No. 1931.** Hairspring Divider, 6 in.
- No. 1934 ¾.** Compass, 6 in., with reversible needle point, divider, pen and pencil parts and lengthening bar.
Metal Handle for parts of Compass.
Key and Box of Leads.
Per set Code Word, **PALADIN**
- Dividers and Compasses equipped with straightening device.

See price list in back of catalog.

ALCO "UNIVERSAL" DRAWING INSTRUMENTS
In Cases



No. 1955PBS

No. 1955PBS. Pocket Book Case, velvet lined, containing:

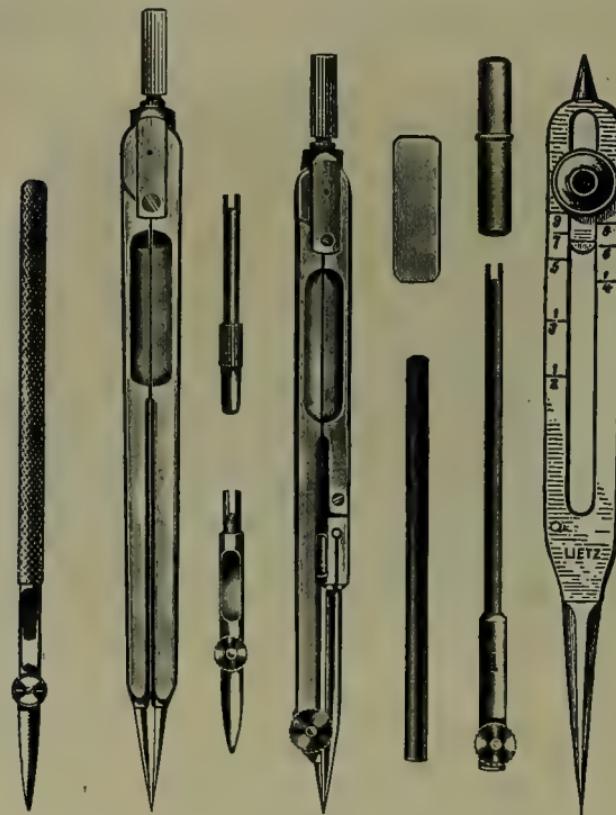
- No. 1900. Ruling Pen, 4½ in., with release lever.
- No. 1902. Ruling Pen, 5½ in., with release lever.
- No. 1910. Bow Divider, 3½ in.
- No. 1912. Bow Pen, 3½ in.
- No. 1914. Bow Pencil, 3½ in.
- No. 1931. Hairspring Divider, 6 in.
- No. 1934¾. Compass, 6 in., with reversible needle point, divider, pen and pencil parts and lengthening bar.
Metal Handle for parts of Compass.
Key and Box of Leads.

Per set Code Word, **PALISADE**

Dividers and Compasses equipped with straightening device.

See price list in back of catalog.

ALCO "JUNIOR" DRAWING INSTRUMENTS



No. 1960 No. 1961G

No. 1964G

No. 1968

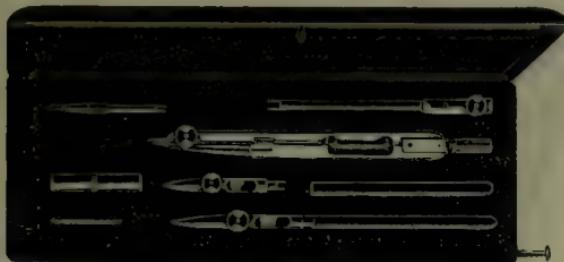
Each

No. 1960.	Ruling Pen, 5 in., metal handle.....
No. 1961G.	Plain Divider, 5½ in.
No. 1964G.	Compass, 5½ in., reversible needle point, divider, pen and pencil parts and lengthening bar, and metal handle for parts.....
No. 1968.	Brass Proportional Dividers, for lines, 6¾ in., in case....
No. 1969.	German Silver Proportional Dividers, for lines and circles, 6¾ in., in case
	Compasses and Dividers equipped with straightening device.
	For other Proportional Dividers see pages 263 and 297.

See price list in back of catalog.

ALCO "JUNIOR" DRAWING INSTRUMENTS

In Cases



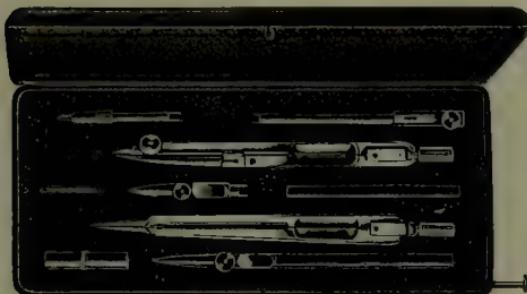
No. 1971BLG

No. 1971BLG. Barlock Case, containing :

No. 1960. Ruling Pen, 5 in., metal handle.

No. 1964. Compass, 5 in., with fixed needle point, divider, pen and pencil parts and lengthening bar.
Key and Box of Leads.

Code Word, **PROCTOR.**



No. 1974BLG

No. 1974BLG. Barlock Case, containing :

No. 1960. Ruling Pen, 5 in., with release lever.

No. 1961. Plain Divider, 5 in.

No. 1964. Compass, 5 in., with fixed needle point, divider, pen and pencil parts and lengthening bar.
Key and Box of Leads.

Code Word, **PROLATE.**

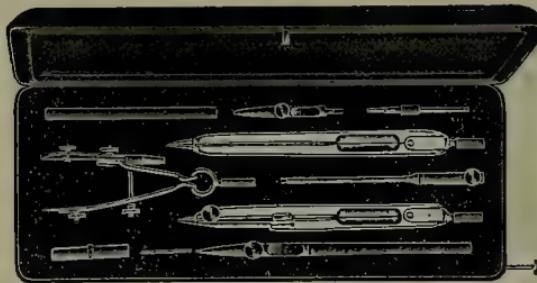
All Dividers and Compasses equipped with straightening device.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

ALCO "JUNIOR" DRAWING INSTRUMENTS

In Cases

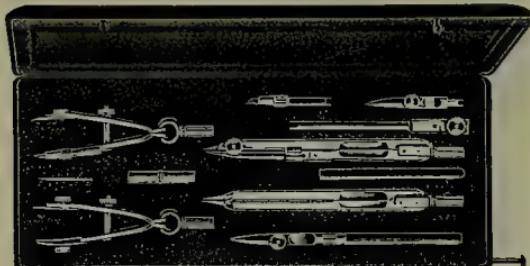


No. 1977½PBR

No. 1977 ½ PBR. Pocket Book Case, containing:

- No. 1960. Ruling Pen, 5 in., with release lever.
No. 1915R. Combination Bow Pen and Pencil.
No. 1961. Plain Divider, 5 in.
No. 1964. Compass, 5 in., with fixed needle point, divider, pen and pencil parts.
Key and Box of Leads.

Code Word, **RADIX**.



No. 1978PBR

No. 1978PBR. Pocket Book Case, containing:

- No. 1960. Ruling Pen, 5 in., with release lever.
No. 1912R. Bow Pen, 3½ in.
No. 1914R. Bow Pencil, 3½ in.
No. 1961. Plain Divider, 5 in.
No. 1964. Compass, 5 in., with fixed needle point leg, divider, pen and pencil parts and lengthening bar.
Key and Box of Leads.

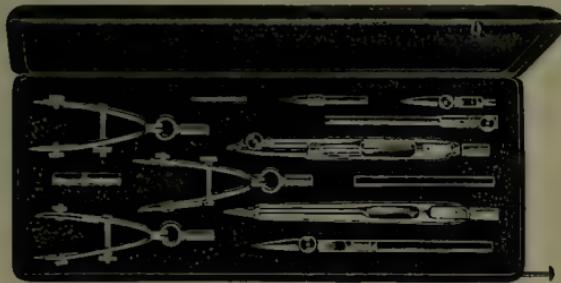
Code Word, **RAFTER**.

All Dividers and Compasses equipped with straightening device.

See price list in back of catalog.

ALCO "JUNIOR" DRAWING INSTRUMENTS

In Cases



No. 1979PBR

No. 1979PBR. Pocket Book Case, containing:

- No. 1960. Ruling Pen, 5 in., with release lever.
- No. 1910R. Bow Divider, 3½ in.
- No. 1912R. Bow Pen, 3½ in.
- No. 1914R. Bow Pencil, 3½ in.
- No. 1961. Plain Divider, 5 in.
- No. 1964. Compass, 5 in., with fixed needle point, divider, pen and pencil parts and lengthening bar.
Metal Handle for parts of compass.
Key and Box of Leads.

Code Word, **RAGSTONE**.

Compasses and Dividers equipped with straightening device.

See price list in back of catalog.

THE A. LIETZ COMPANY

MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS

SAN FRANCISCO, U. S. A.

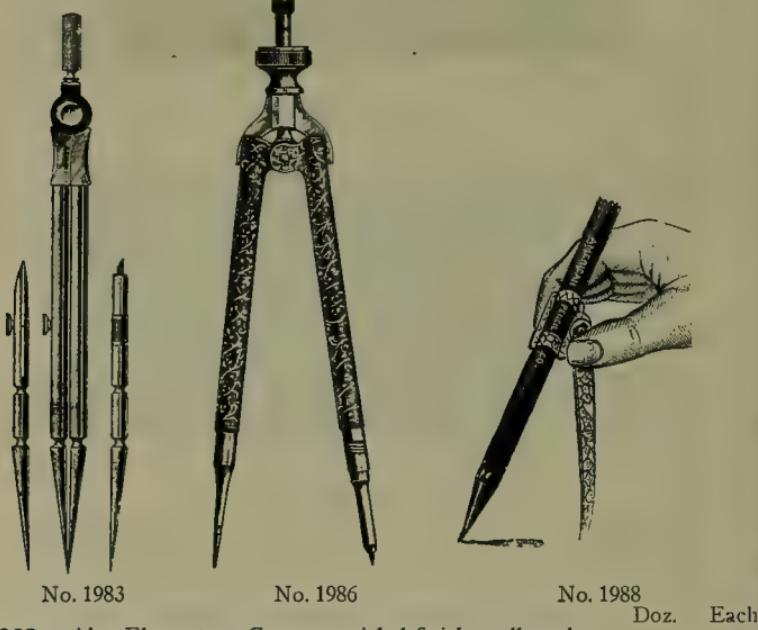
MISCELLANEOUS DRAWING COMPASSES



No. 1982

No. 1982. Alco Primary Compass Set, made of brass, nickel plated, especially adapted for grade schools or elementary drawing. Wooden case, containing Compass, 5 in., with fixed needle point, divider, pen and pencil parts. Metal Handle for parts of compass. Box of Leads and Key.

Each



No. 1983

No. 1986

No. 1988

Doz. Each

No. 1983. Alco Elementary Compass, nickel finish, well made. With interchangeable pen, pencil and divider parts. Contained in cardboard box, with key and box of leads.

No. 1986. "School" Compass, 5½ in., with interchangeable divider, pen and pencil points and box of leads. In cardboard box

No. 1988. "Union" School Compass, No. 2 pencil fitted with adjustable steel point

EXTRA PARTS

For ALCO "SUPERIOR," ALCO "CIRCLE T" and ALCO "UNIVERSAL"
and ALCO "JUNIOR" Drawing Instruments.



No. 4



No. 5



No. 6



No. 7



No. 13½

No. 1985—

Part No.

Each

4	Combination Key and Leadbox.....	
5	Metal Handle for needle, pen or pencil parts of small compasses	
6	Metal Handle for parts of large compasses.....	
7	Center Tack.....	
8	Ebony Handle for ruling pens.....	
9	Aluminum Handle for ruling pens.....	
10	Ivory Handle for ruling pens.....	
11	German Silver Handle for Bow Instruments.....	
13	Screws or Bolt and Nut for pens.....	
13½	Slide Catch Device for pens.....	
14	Bolts for side motion bow instruments.....	
15	Center Motion Screw with left and right thread.....	
20	Divider or needle point part for small compasses.....	
21	Pencil Part for small compasses	
22	Pen part for small compasses.....	
23	Divider or Needle Point part for large compasses.....	
24	Pencil part for large compasses.....	
25	Pen part for large compasses.....	
26	Lengthening Bar for 4 1/4-in. compasses.....	
27	Lengthening Bar for 6-in. compasses	

No. 1987. Tin Box containing 3 leads for instruments.....

When ordering please be sure to specify for which instrument part is wanted.

For Needle Points, Horn Centers, etc., see bottom of page 262.

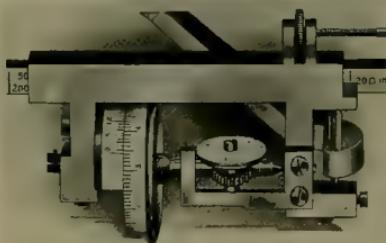
See price list in back of catalog.

PLANIMETERS

This very useful instrument, for obtaining areas, is so well known to the engineer that it hardly need be described in particular. A theoretical discussion of the principles underlying its operation will be found in almost any handbook on higher surveying.

We submit the following instructions and examples for using these instruments:

INSTRUCTIONS FOR USING PLANIMETERS ARRANGED FOR MEASURING AREAS IN SQUARE INCHES (OR OTHER SINGLE UNITS ONLY)



Planimeters Nos. 2000 and 2001.

With needle point **outside** the diagram. Put the instrument on the drawing surface, set the tracing point F at any mark on the outline of the area, then press the needle point E slightly into the paper outside the curve, and read off the roller D and the counting wheel G, taking the whole circumference of the recording roller as the unit of the reading (the roller need not be set to zero).

Readings. The drum of the roller is divided into 100 parts. The tenths of a part are read on the vernier. The complete turns of the roller are read on the counting disc, which advances one line at every complete turn. The counting disc performs one revolution at every 10 turns of the roller.

Each complete reading is a figure of 4 digits, the units being read on the counting disc, the tenths and hundredths on a drum, and the thousandths on the vernier.

The reading of the roller and disc, shown for example in the adjoining figure, is 5.343.

(The zero of the drum and a mark of the disc should simultaneously be opposite the fixed index mark. This is never exactly the case in consequence of the imperfection of the worm wheel gear, and this should be taken into account in making readings in the same way as with a watch, when the minute hand points to 12, while the hour hand fails to indicate the exact hour.)

Then move the tracing point F around the area in the direction of the movement of the hands of a watch till it reaches again the starting point. Now take another reading and subtract the first from the second reading. The difference multiplied by 10 will then be the area of the curve in square inches.

Example: To measure the area of a square of 4-inch sides.

Result: Second reading 3.073

First reading —1.473

$$1.600 \times 10 = 16 \text{ sq. ins.}$$

PLANI METERS

If the reading, before starting, had been 9.521 then the reading after circumscribing the same square as before would be 1.121. As the travel of the roller is in both cases the same, it is evident that the zero mark of the wheel has passed the fixed index mark and that, consequently, the second reading has now to be supplied with one more digit on the left before subtracting the first reading. Thus

$$\begin{array}{r} \text{Complete second reading} & 11.121 \\ \text{first reading} & - 9.521 \\ \hline \end{array}$$

$$1.600 \times 10 = 16 \text{ sq. ins.}$$

With needle point **inside** the diagram. Circumscribe the diagram with the tracing point in the direction of the movement of the hands of a watch, watching at the same time the counter in order to see whether the total rotation of the roller is a forward or a back motion.

This preliminary rough operation being completed proceed as explained before, following the curve carefully with the tracing point. If the total rotation of the roller has been a forward motion, subtract the first from the second reading and add the difference to the figure engraved on the top of the small weight used for keeping the needle point in its place. The sum multiplied by 10 will then be the area of the curve in square inches.

Example: To measure a circle of 18 inches in diameter. (You will see that the total rotation of the roller is forward.)

$$\begin{array}{r} \text{Result: Second reading} & 9.884 \\ \text{first reading} & - 0.868 \\ \hline \end{array}$$

$$9.016$$

$$\begin{array}{r} \text{Figure on weight} & + 16.431 \\ \hline \end{array} \text{ (This figure varies slightly for different instruments.)}$$

$$25.447 \times 10 = 254.47 \text{ sq. ins.}$$

If the total rotation of the roller is a back motion, subtract the second from the first reading and subtract the difference from the figure on the weight.

Example: To measure a square of 11 inch sides. (You will see that the total rotation of the roller is backward.)

$$\begin{array}{r} \text{Result: Complete first reading} & 13.009 \\ \text{second reading} & - 8.678 \\ \hline \end{array}$$

$$4.331$$

$$\begin{array}{r} \text{Figure on weight} & 16.431 \\ \text{Difference of readings} & - 4.331 \\ \hline \end{array}$$

$$12.100 \times 10 = 121 \text{ sq. ins.}$$

NOTE.—When the mark **o** on the roller is at the mark **o** on the vernier a mark of the counting wheel should be opposite the fixed index mark. Any slight noncoincidence due to imperfection of worm wheel gear may readily be allowed for in taking readings.

The area corresponding to a total revolution of the roller—10 sq. ins. in the above example—is engraved on the weight along with the figure before mentioned.

INSTRUCTIONS FOR USING PLANIMETERS ARRANGED FOR MEASURING AREAS IN SEVERAL UNITS AND SCALES

Planimeters Nos. 2005-2010

For illustrations see pages 327-328.

Set the index mark J on the beveled edge of the slide to a convenient division on the bar. There is a clamp and fine adjustment to get this position exactly. The number of units of area per unit of reading and the nature of unit or scale are marked to the right of each division.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

PLANIMETERS

The divisions on the bar are the following:

on back	200 ac 6" = 1 mi	10 ac 1 : 2500	5 ac 1 : 2500
on top	20.811 20.818	21.042 22.107 22.122	
on front	100 □ cm	100 □' $\frac{3}{8}$ " = 1' 200 □' $\frac{1}{4}$ " = 1' 50 □' $\frac{1}{2}$ " = 1' 10 □ in 100 □' $\frac{1}{4}$ " = 1' 400 □' $\frac{1}{8}$ " = 1'	

(The figures on the top of the bar vary slightly for different instruments. The denotation □' means square foot, □ cm = square centimeter, □ in = square inch, ac = acre, mi = mile.)

The slide being set on the bar, place the instrument upon the drawing and measure the diagram as with planimeter No. 2000.

Example: To measure a circle of 5 inches in diameter on a $\frac{1}{4}$ " plan.

Set the index mark J on the slide to the division $200 \square' \frac{1}{4}" = 1'$, press the needle point E outside the circle into the paper, set the tracing point F to any mark of the circle, read off the counter — the reading may be 1.322 — follow the circle with the tracing point until you arrive at the starting point and read again the counter. The reading will then become 2.893.

Result: Second reading	2.893
first reading	— 1.322

$$1.571 \times 200 = 314.2 \text{ sq. ft.}$$

(The multiplier 200 is identical with the figure close to the right of the division used.)

For measuring small diagrams drawn on the $\frac{1}{4}$ " or $\frac{1}{8}$ " scale, the slide may conveniently be set to the last division on the bar marked $100 \square' \frac{1}{4}" = 1'$
 $400 \square' \frac{1}{8}" = 1'$.

If the needle point E be placed inside the diagram to be measured, then one of the figures on the top of the bar must be used in the same way as the figure on the weight of planimeter No. 2000.

Example: To measure a square of 12-inch sides on an ordinance map (scale 1 : 2500).

Set the index mark on the back of the slide to the division 10 ac 1 : 2500.

Suppose that the counter reads 2.482 before starting the tracing point.

In following the outline of the square you will see that the total rotation of the counter is backward and that the zero mark of the counting wheel passes the fixed index once.

Result: Complete first reading	12.482
second reading	— 4.723

$$7.759$$

Figure on top of bar just over the division 22.107
difference of readings — 7.759

$$14.348 \times 10 = 143.48 \text{ acres.}$$

(The multiplier 10 is identical with the denotation 10 ac close to the right of the division used.)

PLANIMETERS NOS. 2015-2022

On these instruments the tracer arm is graduated, and settings can very accurately be made for any scale, either U. S. standard or foreign measurement, and allowances can be made for any shrinkage of the paper. The tracer arm also bears proportion marks for a number of scales for inches and metric measurements.

POLAR PLANIMETERS



No. 2000

No. 2000. Polar Planimeter, German silver, arranged for measuring areas in square inches. Range: Circle, 18 in. in diameter. In neat velvet-lined case, with instructions. Each.....Code Word, **SABOT**

No. 2001. Polar Planimeter, like No. 2000, but without recording wheel "G."Code Word, **SACHEM**



No. 2005

No. 2005. Polar Planimeter, German silver, arranged for measuring areas in several units and scales. Range: Circle 24 in. in diameter. In neat velvet-lined case, with instructions. Each.....Code Word, **SACKBUT**

No. 2006. Polar Planimeter, same as No. 2005, but larger. Range: Circle 42 in. in diameter. In neat velvet-lined case, with instructions. EachCode Word, **SACRUM**

See price list in back of catalog.

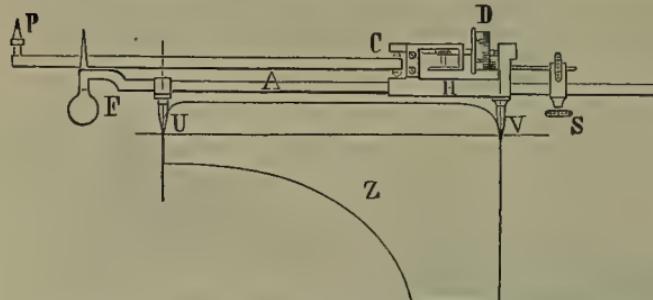
POLAR PLANI METERS



No. 2010

No. 2010. Polar Planimeter, similar to No. 2005, but with special arrangement for rapidly finding the mean height of indicator diagrams (see explanation below). Range: Circle 25 in. in diameter; length of diagrams 2.8 in. In neat velvet-lined case, with instructions. Each.....Code Word, SAFFRON

Arrangement for Finding the Mean Height of Indicator Diagrams



To obtain the mean height of the diagram, hold the instrument upside down, and by shifting the slide on the bar, adjust the two steel points so that they coincide exactly with the length of the diagram. Then place the planimeter without altering the relative position of slide and bar in the usual way upon the drawing—needle point outside the diagram—and follow the outline of the diagram with the tracing point. The difference of the readings at the beginning and at the end of the operation divided by 0.4 will be the mean height of the diagram, expressed in inches.

Example: Second reading 2.361
first reading — 1.913

$$\frac{0.448}{0.4} = 1.12 \text{ ins.} = \text{mean height.}$$

If the diagrams for up and down stroke are measured jointly, divide by 0.8 instead of 0.4.

Mean pressure = Mean height \times Scale of spring of indicator. Supposing the scale of the spring in the above example is $1'' = 80$ lbs. per sq. in., then

$$\text{Mean pressure} = \frac{0.448 \times 80}{0.4} = 89.6 \text{ lbs. per sq. in.}$$

The number of pounds per inch of height being usually a multiple of 4, the arithmetical work is thus extremely simple.

See price list in back of catalog.

POLAR PLANI METERS



No. 2015

No. 2015. Polar Planimeter, German silver, tracer arm fully divided for settings in any scale, U. S. Standard or foreign, also bearing proportion marks for a number of scales for inches and metric measurements, fitted with clamp and tangent screw and ball pole instead of needle point, in morocco velvet-lined case. Each.....
.....Code Word, **SAGAMORE**

COMPENSATING PLANI METERS

Compensating Planimeters Nos. 2020, 2021 and 2022 are in two separate parts: one is the tracer arm with measuring and recording wheels, the other the polar arm, having the pole weight at one end and a steel ball at the other, which forms a ball joint with the carriage. The ball joint cannot become loose or shaky, nor is it liable to be injured when adjusting the tracer arm or during shipment, as each part is stored in the case separately. This construction gives the tracer arm a motion of 180° in either direction, therefore the range of these instruments is much greater than that of the ordinary planimeters.

The pole is so constructed as to combine the advantages of the pole plate and the needle point, as the point need not be pressed into the paper and may be used for setting the roller to zero without touching the measuring roller.

By measuring a diagram with the pole on the right, and then on the left side of the tracer arm, and taking the mean of the readings, all errors of the instrument are compensated.

See price list in back of catalog.

COMPENSATING PLANIMETERS



No. 2020

No. 2020. Compensating Planimeter, German silver and bronze, adjustable tracer arm with graduation from 270 to 350, improved pole weight, testing rule. In morocco velvet-lined case, with instructions. Each..Code Word, **SAGAS**



No. 2021

No. 2021. Compensating Planimeter, German silver and bronze, adjustable tracer arm fully graduated for settings in any scale, and with proportion marks for a number of scales for inches and metric measurements. Fitted with clamp and tangent screw, improved pole weight, testing rule, in morocco velvet-lined case, with instructions. Each.....Code Word, **SAGUM**
No. 2022. Compensating Planimeter, like No. 2021, but with adjustable pole arm (see note below), in morocco velvet-lined case, with instructions. Each.....Code Word, **SAIGA**

THE ADJUSTABLE POLE ARM

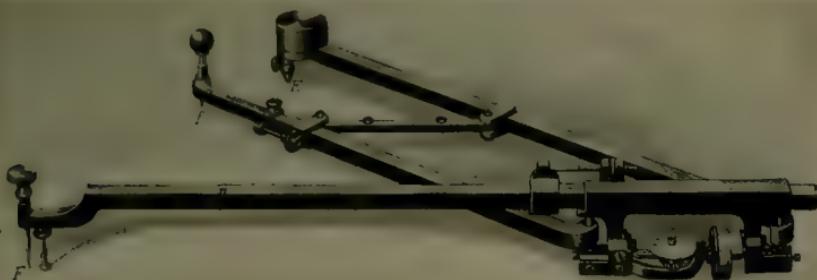


No. 2022

The adjustable pole arm, extending to about 18 inches, bears index marks for the different settings furnished with the instrument, and can be adjusted so that when the instrument is used with the pole inside of a figure, the constant is a round number, 20,000 for any setting. The instrument is used in the same way with the pole inside as with the pole outside, and by tracing the figure with the pole on the right and on the left of the tracer arm (about 18 inches) and taking the mean of the readings, large areas can be measured with great accuracy. The extensibility of the pole arm and the great range of the tracer arm permit of measuring very large figures with the pole outside. By reducing the length of the pole and tracer arms, the instrument can be used in a very small space.

See price list in back of catalog.

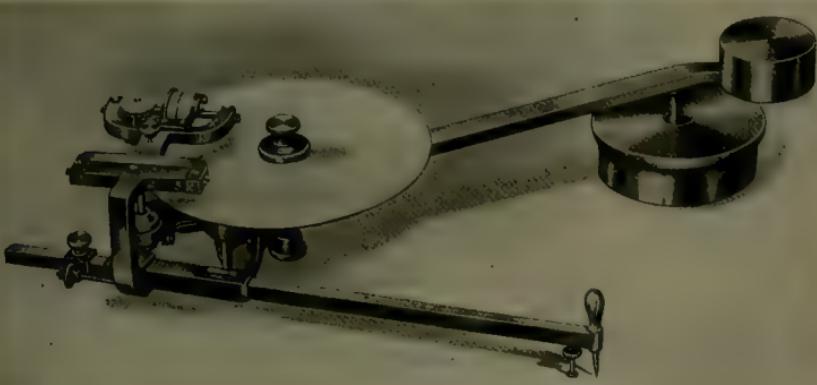
POLAR PLANIMETERS



No. 2025

No. 2025. Pantograph Polar Planimeter, German silver, with two adjustable tracer arms arranged for measuring areas in several units and scales. In neat velvet-lined case, with instructions. Each.....Code Word, **SALLET**

Pantograph Polar Planimeter is particularly well adapted for measuring very large or very small areas. The long tracer arm has a range of a circle about 38" in diameter. When using the long tracer arm it is advisable to remove the tracing point of the short arm, and the figure is traced in the usual manner. The short tracer arm is used for measuring very small areas. The tracing point is set on the figure, and the tracing point of the LONGER arm is so guided that the tracing point of the shorter arm follows the outline. As the two tracing points move alike, this is very easily manipulated. When using the short tracing arm in this manner the travel of the measuring wheel for the area is increased, in consequence of which the value of the wheel unit is smaller, and more accurate results are obtained.



No. 2028

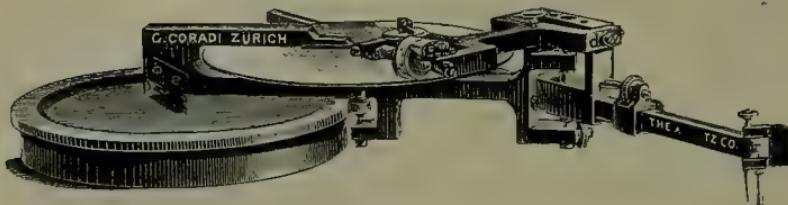
No. 2028. Polar Disc Planimeter, German silver, adjustable tracer arm arranged for measuring areas in several units and scales. Range: Area enclosed between two concentric circles of 31 and 18 inches in diameter. In neat velvet-lined case. Each

The Polar Disc Planimeter is especially useful when figures are traced on paper that has been folded, rolled, etc., as the measuring wheel revolves on a plane disc instead of over the paper being traced. The paper on the disc can easily be renewed at any time by removing the screw nut on top of the disc. More accurate results are thus obtained when tracing on paper where the surface has in any manner been damaged.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
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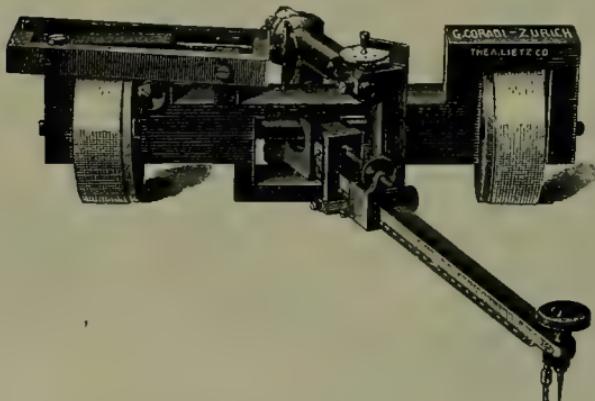
POLAR PLANI METERS



No. 2029

No. 2029. Polar Disc Planimeter, German silver and bronze, aluminum paper covered disc for measuring wheel, adjustable tracer arm fully divided for settings in any scale, with micrometer adjustment, adjustable for vernier unit from .003 sq. in. to .008 sq. in. In morocco velvet-lined case, with testing rule and instructions. Each Code Word, **SALPINX**

ROLLING PLANI METERS



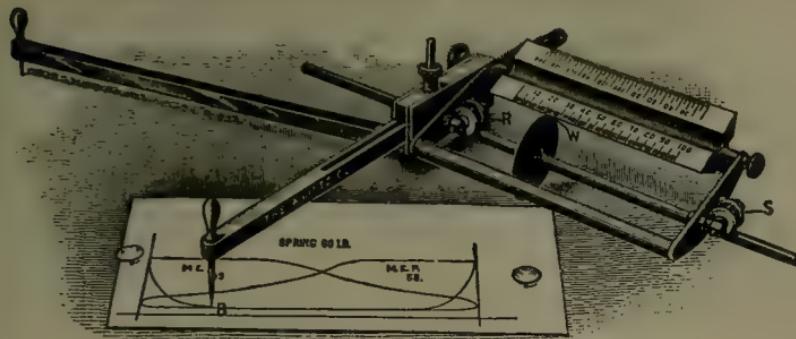
No. 2030

No. 2030. Precision Rolling Planimeter, German silver and bronze, adjustable tracer arm 10 inches long, fully graduated, with 8-in. telescoping extension. In morocco velvet-lined case, with testing rule, instructions. Each Code Word, **SALTANT**

The Precision Rolling Planimeter has an angular motion of about 90 degrees. The two rollers are made of exactly equal diameters, insuring a motion of the instrument, as a whole, in a straight line. The area of a figure of any length, the width of which does not exceed the length of the extended tracer arm, can be measured in one operation.

See price list in back of catalog.

IMPROVED WILLIS PLANIMETER



No. 2035

No. 2035. Improved Willis Planimeter, in neat leather-covered case
 $1\frac{1}{2} \times 3\frac{1}{2} \times 9\frac{1}{2}$, complete with instructions. Each.....**SALVO**

The Improved Willis Planimeter reads M. E. P. direct from indicator diagram, gives areas of regular or irregular circles or diagrams in square inches, feet and yards without any computation.

The usual planimeter has a recording wheel whose axle is parallel to the tracer bar. This wheel scrapes along the paper for all movements parallel to the tracer bar, and records by rotating all movements perpendicular to it. The instrument to which we call attention acts on an entirely different principle. The wheel (W) rolls for all movements parallel to the tracer bar and its steel spindle glides beneath roller for all perpendicular movements. After tracing a figure the result is read from the scale next to the wheel; this scale being triangular, has six graduated edges, any one of which can be brought next to the wheel, thus permitting reading to be taken in the unit best suited to the work.

The recording wheel of the improved Willis Planimeter is made of steel and has a sharp edge, which takes firm hold upon the paper or material upon which the instrument is operated, and the long steel shaft of this wheel glides freely beneath the rollers (R) and (S), which practically bear the weight of the instrument, and make it absolutely frictionless. This construction gives great ease of movement, and the instrument is handled as readily on a rough table as on the finest paper. As the rotary movement is not registered, it is apparent that the accuracy of the instrument is not affected by the character of the paper or material upon which the instrument is operated, or by any slight reduction of the diameter of the wheel or injury to the knife edge. This is one of the most important points to be considered in the selection of a planimeter.

SCALES FOR INDICATOR DIAGRAMS

No. 2040. Flat Boxwood Scales 4 inches long, one edge beveled and divided.
A B C D E F G H I J K
Parts to inch..... 10 20 40 50 60 80 100 12 24 32 64
Each.....

No. 2041. Set of 11 Scales, as listed above, in mahogany case.....
No. 2042. Triangular Boxwood Scales, 3 in., six edges divided:

A	Indicator Scales, graduated 10, 20, 30, 40, 50, 60 parts to in.	Each
B	Indicator Scales, graduated 20, 40, 50, 60, 80, 100 parts to in.	Each
C	Indicator Scales, graduated 10, 15, 25, 30, 40, 70 parts to in.	Each
D	Indicator Scales, graduated 10, 20, 25, 60, 80, 100 parts to in.	Each
E	Indicator Scales, graduated 12, 24, 32, 64, 40, 60 parts to in.	Each

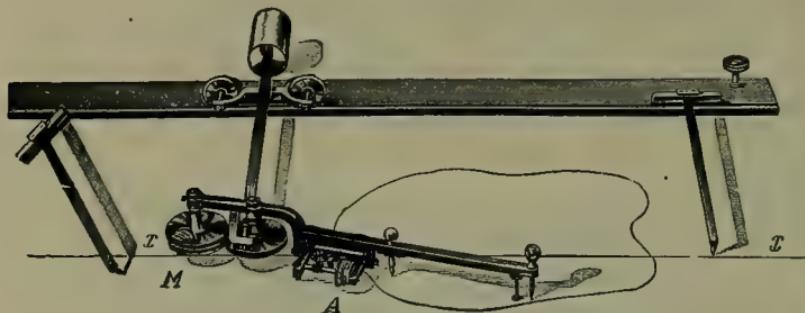
Indicator Scales with other graduations made to order.

See price list in back of catalog.

MECHANICAL INTEGRATORS

With the aid of these instruments it is possible to ascertain the area and moments relative to an axis of any figure, by simply tracing its outline. They greatly facilitate the finding of the displacement, moments of stability and inertia, center of gravity, etc., of ships, the tensile strength, resistance, safe load, etc., of tracks, cables, beams, contents of embankments, etc. The readings are taken from the recording discs. These instruments are very simple, and can be used by anybody after a little practice.

AMSLER'S MECHANICAL INTEGRATOR



No. 2045

- No. 2045.** Amsler's Mechanical Integrator, German silver, with two recording mechanisms, giving the area and moment of any figure, two tracing points, grooved steel straight edge 29 in. long, in case, with instructions. Each.....Code Word, **SAMPAN**
No. 2046. Amsler's Mechanical Integrator, same as No. 2045, but brass instead of German silver. Each.....Code Word, **SANDAL**

Grooved steel straight edges of other lengths to order.

Amsler's Mechanical Integrators **Nos. 2045** and **2046** are provided with two tracing points, for large and small figures. When using the one nearest to the center of rotation of the instrument, the travel of the measuring wheel is increased, as a consequence the area value of the wheel unit is smaller, and more accurate results are obtained. Very large figures can be measured in sections. By means of a formula furnished with each instrument, area and moment of figures drawn to scale can be easily obtained.

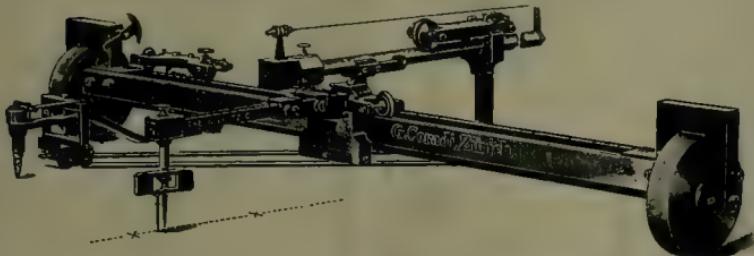
See price list in back of catalog.

THE MECHANICAL INTEGRAPH

The Integraph is an integrator which not only indicates the final result of the integration, but also gives a graphic representation thereof. While the tracer travels around the outline of the figure, the integraph automatically draws an integral curve the ordinates of which are proportionate to the area of the figure traveled around ($y_1 = f y \, dx$). If this first integral curve is traced by the tracer of the integraph as a differential curve, the tracer draws a second integral curve the ordinates of which are proportional to the moment of stability ($y_2 = f y^2 \, dx$). By tracing this second integral curve we obtain a third integral curve the ordinates of which are proportional to the moment of inertia ($y_3 = f y^3 \, dx$) etc. The y-axis for the moments can be chosen anywhere on the curve, i. e., it can be shifted. By means of the integraph many of the most difficult calculations and problems occurring in the practice of an engineer can be solved in a simple and reliable manner and with much saving of time and the operator need not possess any knowledge of higher mathematics.

The applications of the integraph are very numerous. With it we calculate areas, divide areas, determine centers of gravity, calculate moments of stability, load and resistance, solve algebraical equations, etc.

CORADI'S MECHANICAL INTEGRAPH



No. 2055

No. 2055. Coradi's Mechanical Integraph, German silver and bronze, tracer arm graduated to 1/10 inches with vernier reading to 1/100 inches with micrometer screw. Instrument complete in case with testing rule, instructions. Each.....Code Word, **SANDCONE**

Coradi's Mechanical Integraph moves on two broad rollers. The carriages of the tracing and integrating points have a lateral travel of 10.3 inches. The base can be set from 1.5 to 5.2 inches.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
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SAN FRANCISCO, U. S. A.

PRECISION PANTOGRAPHS



No. 2075

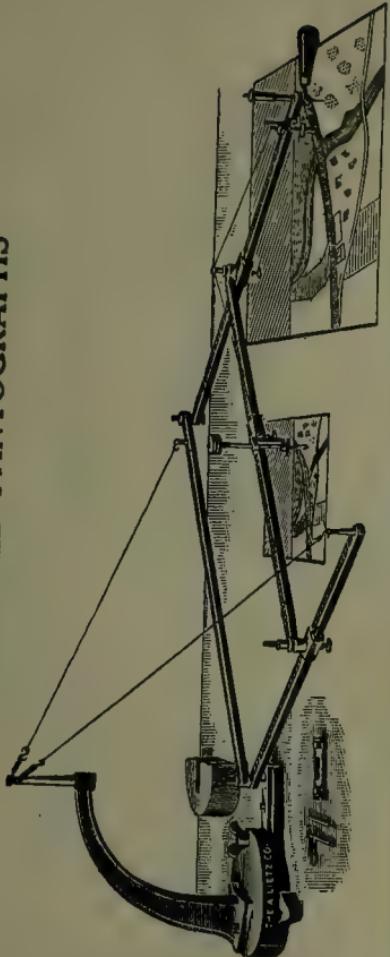
FOR ENLARGING FROM 1:1 TO 1:20 AND REDUCING FROM 20:1 TO 1:1, IN ALL RATIOS

No. 2075. Suspended Precision Pantograph, square metal bars 33 in. long, graduated throughout, with vernier and micrometer adjustments, extra supporting bar and appliances for setting up instrument with the pole within the parallelogram, for reproducing in the size of the original. Instrument complete with all usual accessories; in polished box with lock and key. Each.....

No. 2076. Do, but length of bars 38 in.....

See price list in back of catalog.

SUSPENDED PANTOGRAPHS



No. 2080

FOR ENLARGING FROM 1:20 TO 4:5 AND REDUCING FROM 20:1 TO 5:4, IN ALL RATIOS

No. 2080. Suspended Pantograph, square metal bars 28 in. long, graduated throughout, sliding sockets with bevelled edges to facilitate the reading of ratios. Instrument complete with all usual accessories, in polished box with lock and key. Each.....

No. 2081. Do., but length of bars 33 in.....

No. 2082. Do., but length of bars 38 in.....

Pantographs Nos. 2075 to 2082 are furnished with a Tracing Point, a Dotting Needle, a Lead Pencil Slide and a Reverse Dotted Needle; 3 or 4 Brass Weights to weigh down the needle and lead pencil; a small Set Level and Instructions for use. The joints run on cone-shaped steel pivots, to assure an accurate and easy movement.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

SUSPENDED PANTOGRAPH

Pearwood Bars



No. 2085

FOR ENLARGING AND REDUCING IN THE FOLLOWING RATIOS:

1:20, 1:12, 1:10, 1:8, 1:6, 1:5, 1:4, 1:3, 2:5, 1:2, 3:5, 2:3, 3:4, 4:5, AND VICE VERSA

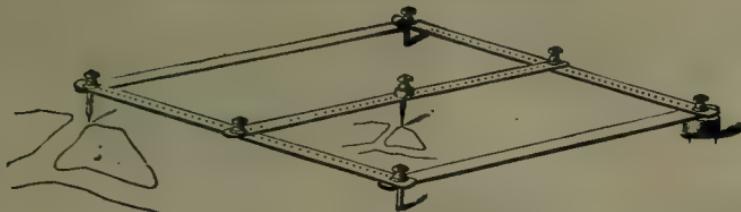
No. 2085. Suspended Pantograph, strong pearwood bars, 28 in. long, made of well seasoned material, with holes accurately spaced for the above ratios. Instrument complete with all usual accessories, in polished box with lock and key. Each.....

No. 2087. Do., but length of bars 38 in.

Pantographs Nos. 2085 and 2087 are furnished with a Tracing Point, Steel Point, Pencil Point, 3 Brass Weights to weigh down needles, and Box of Leads. The joints are made of polished steel cones in metal sockets to assure an accurate and easy movement.

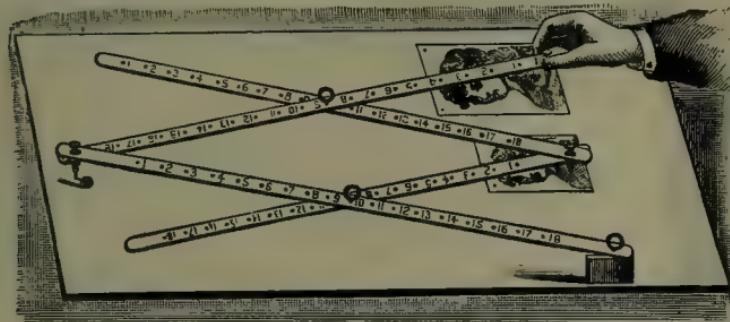
See price list in back of catalog.

WOODEN PANTOGRAPHS



No. 2090

No. 2090. Pantograph of polished hardwood, bars $22\frac{1}{2}$ in. long, for reducing and enlarging drawings from 2:1 to 16:1 or vice versa, in box with directions. Each



No. 2092

No. 2092. Pantograph of polished hardwood, bars 21 in. long, for reducing and enlarging drawings from 8:1 to $1\frac{1}{8}:1$ or vice versa, with nickel-plated screw-eye joints and elbow-wheel, in box with directions. Each

No. 2094. Same as No. 2092, but wood not polished and brass instead of nickel-plated mountings, in box with directions. Each

No. 2095. Same as No. 2094, but movable point at elbow instead of wheel; in box with directions. Each

No. 2096. Pantograph, hardwood not polished, with neat and substantial trimmings. Each

No. 2097. Pantograph, small, for school purposes. Each

HARDWOOD PANTOGRAPH

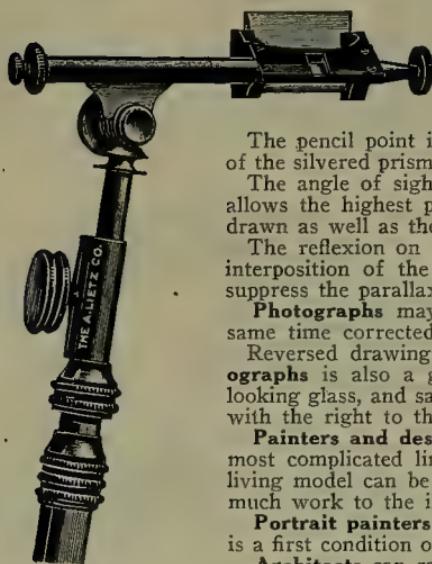
High Quality.

No. 2099. Pantograph of polished inlaid hardwood, bars 41 in. long, for reducing and enlarging drawings from 8:1 to $1\frac{1}{8}:1$ or vice versa, with nickel-plated joints comprised of bolts and thumbnuts, and metal foot; in box with directions. Each

See price list in back of catalog.

CAMERA LUCIDA

AN INSTRUMENT OF GREAT VALUE TO THE ARTIST, ARCHITECT,
ENGINEER, NEWSPAPER AND ADVERTISING SPECIALISTS
AND STUDENTS



The Camera Lucida is useful for any kind of drawing.

Enlargements (up to 36 times when the rod is at its full length) and reductions can be made from nature or from documents.

The pencil point is clearly seen, and the special cutting of the silvered prism makes it twice as luminous as the old.

The angle of sight is 90° instead of the old 45° . This allows the highest points above the line of horizon to be drawn as well as the ground or first plan.

The reflexion on the paper is perfectly steadied by the interposition of the lenses (12 different focuses). These suppress the parallax.

Photographs may be enlarged or reduced, and at the same time corrected, if the vertical lines are converging.

Reversed drawing for Etchings, Engravings and Lithographs is also a great feature; it does away with the looking glass, and saves much time, as the copy is reversed with the right to the left.

Painters and designers can outline with exactitude the most complicated lines of perspective, scenery, or even a living model can be sketched in a few moments, reducing much work to the illustrator.

Portrait painters are guided to the correct pose, which is a first condition of success.

Architects can rapidly draw a sculpture or enlarge the photograph of a monument, and can copy to a scale the most complicated geometrical drawings without searching.

Industrial designers of fashions, furnishing, jewelry, etc., will save much time by using this camera.

Engineers and surveyors will find it most useful for copying maps, plans, or any document, to any scale.

For amateurs, it provides a charming pastime for in and out of doors, without previous study.



No. 2101C. Camera Lucida with three draw telescopic slide bar, the last with rack and pinion movement, nickel finish; fullest length, 25 inches, and 12 lenses of different focuses; complete in black leather case, lined with velvet and silk; size, $11 \times 2 \frac{1}{4} \times 1 \frac{1}{4}$; Code Word, SATURN

No. 2101D. Camera Lucida with one draw telescopic slide bar in polished brass fullest length 20 inches, and 12 lenses of different focuses; complete in waxed walnut box, green cloth lined, spring clasp; size $11 \frac{1}{4} \times 2 \frac{1}{2}$ Code Word, SATYR

See price list in back of catalog.

MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS THE A. LIETZ COMPANY
SAN FRANCISCO, U. S. A.

MAP MEASURES

For measuring curved or straight lines.



No. 2103

- No. 2103. Map Measure, $1\frac{1}{4}$ in. dial, fixed metal handle, with two graduations: inches to miles and centimeters to kilometers.....

Each



No. 2104

- No. 2104. Map Measure, same as No. 2103, but with swiveling metal handle....

Each



No. 2105



No. 2106-7

- No. 2105. Map Measure, watch pattern, $1\frac{1}{4}$ in. diameter, three dials, registering 100 feet in feet, inches and eighths, with zero setting device.....

Each

- No. 2106. Map Measure, watch pattern, 1 in. dial registering 25 feet in single feet, inches and eighths.....

- No. 2107. Map Measure, same as No. 2105 but $1\frac{1}{4}$ in. dial.....

To measure a line the instrument should be set to zero. The projecting wheel is then run along the line in one direction, the index hands indicating the length of line in feet, inches and eighths.

See price list in back of catalog.

ALCO SUPERIOR PROTRACTORS

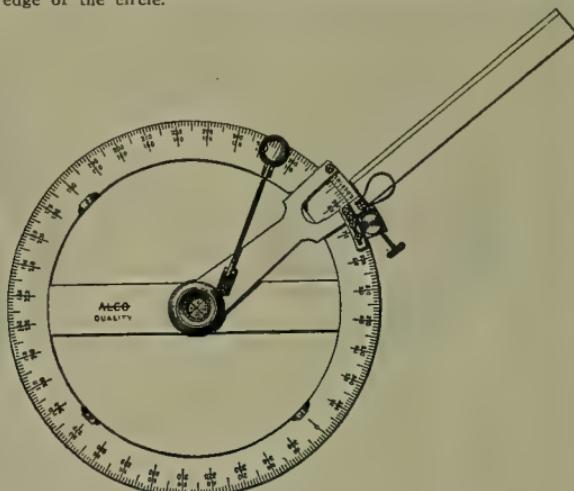
Three-Arm Protractor or Station Pointer
As made by us for the U. S. Navy Department.



No. 2110

No. 2110. Three-Arm Protractor or Station Pointer, in polished mahogany box, complete. Each

Lietz Three-Arm Protractor No. 2110 is divided on solid silver to half degrees and numbered in opposite directions from 0 to 360, with two verniers reading to single minutes. Both verniers with tangent screw. Size of circle 6½ inches. Magnifying glass on swinging arm. Three arms made of German silver, each 17 inches long with extension pieces to lengthen to 27½ inches beyond the edge of the circle.



Nos. 2116-17 with 2118

No. 2116. Circular German Silver Protractor, 8 in., with clamp screw and micrometer to vernier, with horn center and movable arm 6 in. long, divided to $\frac{1}{4}$ degrees, vernier reading to 1 minute. Each

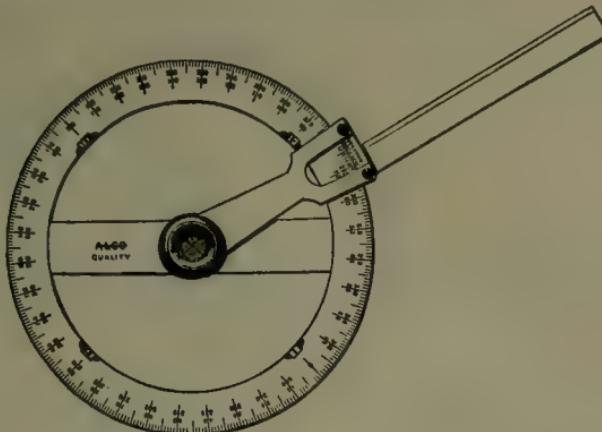
No. 2117. Same as No. 2116 but 10 in. and movable arm 6½ in. long. Each....

No. 2118. Attached Reading Glass on swinging arm for Protractors Nos. 2116, 2117, 2128 and 2129.....

For Morocco Cases for the above Protractors see bottom of page 343.

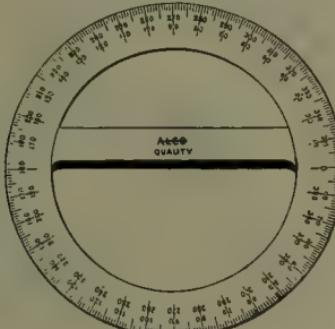
See price list in back of catalog.

ALCO SUPERIOR PROTRACTORS



Nos. 2120-22

- No. 2120. Circular German Silver Protractor, 5½ in., with horn center and movable arm 5½ in. long, divided to $\frac{1}{2}$ degrees, vernier reading to 8 minutes. Each
- No. 2121. Same as No. 2120 but 8 in. and movable arm 6 in. long, divided to $\frac{1}{4}$ degrees, vernier reading to 1 minute. Each.....
- No. 2122. Same as No. 2120 but 10 in. and movable arm 6½ in. long, divided to $\frac{1}{4}$ degrees, vernier reading to 1 minute. Each.....
For Morocco Cases for the above Protractors see bottom of page.



No. 2126

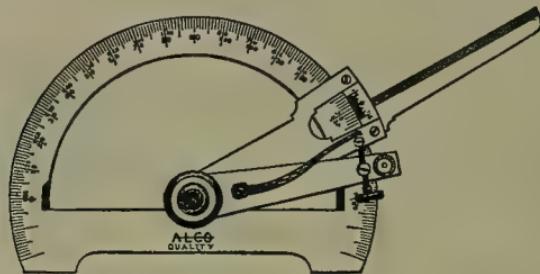
- No. 2126. Circular German Silver Protractor, 6 in., beveled edge, divided to $\frac{1}{2}$ degrees. Each

MOROCCO CASES FOR CIRCULAR ARM PROTRACTORS

- Morocco Case for No. 2120. Each
- Morocco Case for No. 2116 or 2121. Each
- Morocco Case for No. 2117 or 2122. Each

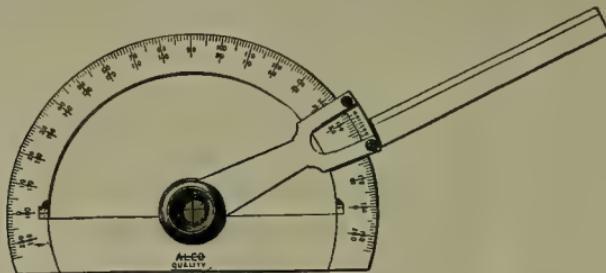
See price list in back of catalog.

ALCO SUPERIOR PROTRACTORS



Nos. 2128-29

- No. 2128.** Semicircular German Silver Protractor, 8 in., with clamp screw and micrometer to vernier, horn center, and movable arm 6 in. long, divided to $\frac{1}{4}$ deg., vernier reading to 1 minute. Each....
No. 2129. Same as No. 2128, but 10 in., and movable arm $6\frac{1}{2}$ in. long. Each.....
No. 2118. Attached Reading Glass on swinging arm for Protractors Nos. 2128 and 2129



Nos. 2135-37

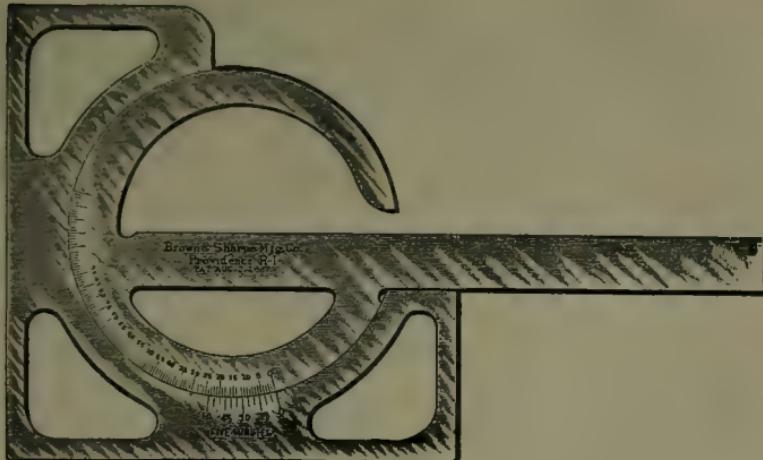
- No. 2135.** Semicircular German silver Protractor, $5\frac{1}{2}$ in., with horn center, and movable arm $5\frac{1}{2}$ in. long, divided to $\frac{1}{2}$ deg., vernier reading to 3 minutes. Each.....
No. 2136. Same as No. 2135, but 8 in., and movable arm 6 in. long, divided to $\frac{1}{4}$ deg., vernier reading to 1 minute. Each.....
No. 2137. Same as No. 2135, but 10 in., and movable arm $6\frac{1}{2}$ in. long, divided to $\frac{1}{4}$ deg., vernier reading to 1 minute. Each.....

MOROCCO CASES FOR SEMICIRCULAR ARM PROTRACTORS

- Morocco Case for No. 2135. Each.....
Morocco Case for No. 2128 or No. 2136. Each.....
Morocco Case for No. 2129 or No. 2137. Each.....

See price list in back of catalog.

DRAFTSMEN'S PROTRACTORS



No. 2150

No. 2150. Draftsmen's Steel Protractor with 8½ in. blade, graduated to single degrees, vernier reading to 5 minutes. Each.....

No. 2151. Morocco Case for Protractor No. 2150. Each.....

Draftsmen's Protractor No. 2150 is made of sheet steel and is light and durable. This Protractor can be quickly set to any angle. It can be used either side up and on either of the two outside edges of the frame. Advantageously used in dividing circles, transferring angles, or laying off given angles, without resetting, on either side of a line. It forms a convenient extension of a T-square and frequently takes the place of 45-degree and 60-degree angles.



No. 2156

No. 2156. Draftsmen's Steel Protractor with 9 in. blade, arc 4 in. in diameter, graduated to single degrees, vernier reading to 5 minutes. Each....

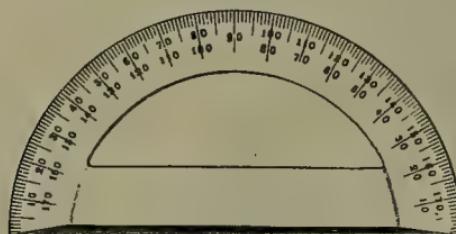
No. 2157. Mahogany Case for Protractor No. 2156. Each.....

Draftsmen's Protractor No. 2156 has a clamping screw which securely holds the blade at any angle, and also serves as a knob.

Either blade can be used in contact with a T-square, giving any angle and its complement from 0° to 90°.

See price list in back of catalog.

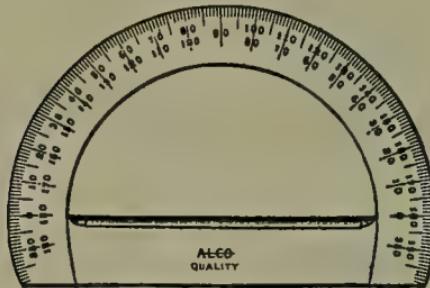
ALCO SUPERIOR PROTRACTORS



Nos. 2160-65

Center on outer edge.

- No. 2160. Semicircular German silver Protractor, 4 in., beveled edge, divided to 1 degree. Each
- No. 2161. Do., 5 in., divided to $\frac{1}{2}$ degree. Each.....
- No. 2162. Do., 6 in., divided to $\frac{1}{2}$ degree. Each.....
- No. 2163. Do., 6 in., divided to $\frac{1}{4}$ degree. Each.....
- No. 2165. Do., 8 in., divided to $\frac{1}{4}$ degree. Each.....



Nos. 2171-73

Center on inner edge.

- No. 2171. Semicircular German silver Protractor, 5 in., beveled edge, divided to $\frac{1}{2}$ degree. Each
- No. 2172. Do., 6 in., divided to $\frac{1}{2}$ degree. Each.....
- No. 2173. Do., 6 in., divided to $\frac{1}{4}$ degree. Each.....

See price list in back of catalog.

METAL PROTRACTORS



Nos. 2180-84



Nos. 2189-93

German Silver

- No. 2180. Semicircular German silver Protractor, 4 in., divided to 1° . Each....
 No. 2181. Semicircular German silver Protractor, 5 in., divided to $\frac{1}{2}^{\circ}$. Each....
 No. 2182. Semicircular German silver Protractor, 6 in., divided to $\frac{1}{2}^{\circ}$. Each....
 No. 2184. Semicircular German silver Protractor, 8 in., divided to $\frac{1}{2}^{\circ}$. Each....

Brass.

- No. 2189. Semicircular brass Protractor, $3\frac{1}{2}$ in., divided to 1° . Each.....
 No. 2190. Semicircular brass Protractor, 4 in., divided to 1° . Each.....
 No. 2191. Semicircular brass Protractor, $4\frac{1}{4}$ in., divided to 1° . Each.....
 No. 2192. Semicircular brass Protractor, $5\frac{1}{2}$ in., divided to $\frac{1}{2}^{\circ}$. Each.....
 No. 2193. Semicircular brass Protractor, $6\frac{1}{4}$ in., divided to $\frac{1}{2}^{\circ}$. Each.....

PAPER PROTRACTORS



Nos. 2201-2205

- No. 2201. Circular Protractor on Drawing Paper, 14 in. diam. in $\frac{1}{4}^{\circ}$
 No. 2202. Circular Protractor on Bristol Board, 8 in. diam. in $\frac{1}{2}^{\circ}$
 No. 2203. Circular Protractor on Bristol Board, 14 in. diam. in $\frac{1}{4}^{\circ}$
 No. 2204. Circular Protractor on Tracing Paper, 8 in. diam. in $\frac{1}{2}^{\circ}$
 No. 2205. Circular Protractor on Tracing Paper, 14 in. diam. in $\frac{1}{4}^{\circ}$

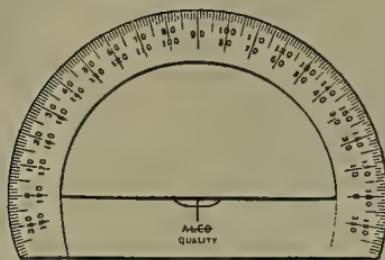
PAPER PROTRACTORS MOUNTED ON LINEN

- No. 2202M. Circular Protractor, Bristol Board mounted on linen, 8 in. diam.
 in $\frac{1}{2}^{\circ}$
 No. 2203M. Circular Protractor, Bristol Board mounted on linen, 14 in. diam.
 in $\frac{1}{4}^{\circ}$

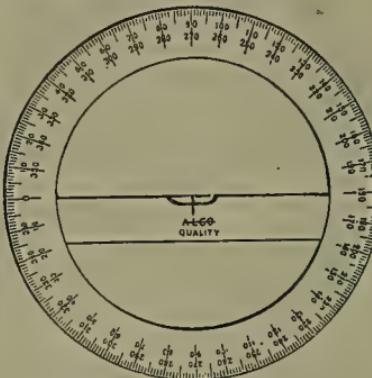
See price list in back of catalog.

ALCO TRANSPARENT PROTRACTORS

Heavy, with Beveled Edges



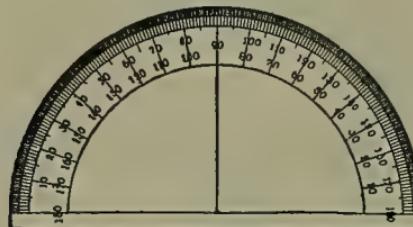
Nos. 2210-11



Nos. 2215-17

- No. 2210. Semicircular Amber Protractor, 6 in., divided to $\frac{1}{2}^{\circ}$. Each
No. 2211. Semicircular Amber Protractor, 8 in., divided to $\frac{1}{2}^{\circ}$. Each
No. 2215. Circular Amber Protractor, 6 in., divided to $\frac{1}{2}^{\circ}$. Each...
No. 2216. Circular Amber Protractor, 8 in., divided to $\frac{1}{2}^{\circ}$. Each...
No. 2217. Circular Amber Protractor, 10 in., divided to $\frac{1}{2}^{\circ}$. Each...

TRANSPARENT CELLULOID PROTRACTORS

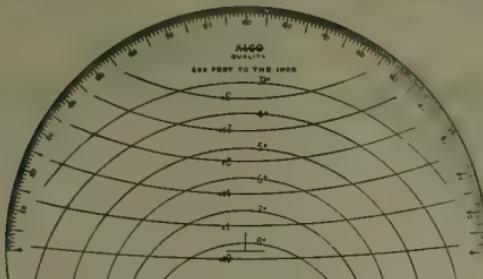


Nos. 2230-35

- No. 2230. Semicircular Celluloid Protractor, 4 in., divided to $\frac{1}{2}^{\circ}$..
No. 2231. Semicircular Celluloid Protractor, 5 in., divided to $\frac{1}{2}^{\circ}$..
No. 2232. Semicircular Celluloid Protractor, 6 in., divided to $\frac{1}{2}^{\circ}$..
No. 2234. Semicircular Celluloid Protractor, 8 in., divided to $\frac{1}{2}^{\circ}$..
No. 2235. Semicircular Celluloid Protractor, 10 in., divided to $\frac{1}{2}^{\circ}$..

See price list in back of catalog.

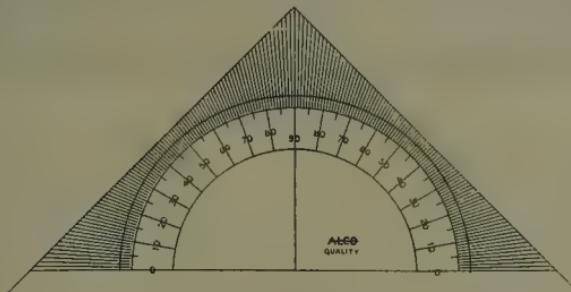
RAILROAD CURVE PROTRACTORS



No. 2241

No. 2241. Transparent Amber Railroad Curve Protractor, 10 in., divided to $\frac{1}{2}^{\circ}$ with circular curves from 1° to 20° , scale 100 feet to the inch. Each

TRANSPARENT TRIANGLE PROTRACTORS

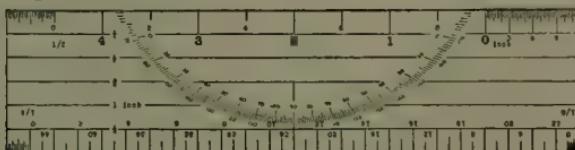


Nos. 2250-52

No. 2246. Amber Triangle Protractor, $30 \times 60^\circ$, 6 in., divided to 1° . Ea.
No. 2247. Amber Triangle Protractor, $30 \times 60^\circ$, 7 in., divided to 1° . Ea.
No. 2250. Amber Triangle Protractor, 45° , 5 in., divided to 1° . Ea.
No. 2252. Amber Triangle Protractor, 45° , 7 in., divided to 1° . Ea.

TRANSPARENT PLOTTING PROTRACTORS

No. 2255. Transparent Plotting Protractor, with arms, 8 in. long. Ea.
No. 2256. Engineers' Field Book Assistant and Protractor. Ea.....

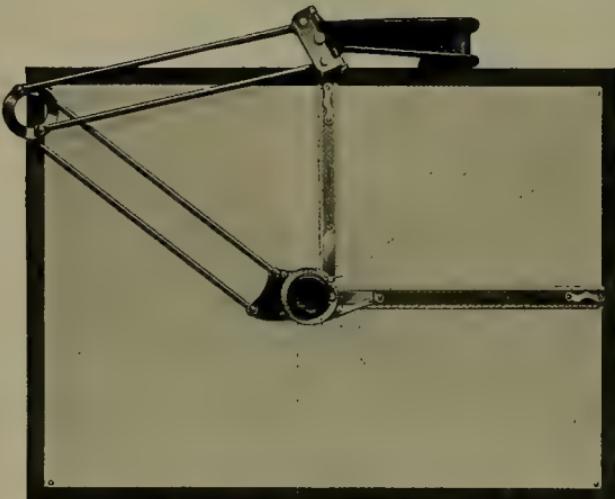


Nos. 2260-65. Transparent Scale Protractors.....

For complete description and illustrations of Protractors Nos. 2255 and 2265 see page 206.

See price list in back of catalog.

THE UNIVERSAL DRAFTING MACHINE



Cut shows Mid-Anchor Machine

The Universal Drafting Machine consists of two parallelograms, a protractor, and a square having graduated ruling edges. The blades of the square are interchangeable for all graduations.

The two parallelograms joined together constitute an arm which, anchored to the board, gives the protractor and square a parallel motion about the drawing. This form of parallel motion permits either zero or the ruling edges to be instantly placed at any point on the drawing, by a single direct movement, and a line being drawn along the graduated ruling edge, just the exact length required.

A conveniently arranged protractor permits the square to be set at any angle, and it then has the same parallel motion about the board as when set at zero. Machines are furnished with either of the three following protractors.

STANDARD PROTRACTOR. Has graduated arc allowing square to be set at any angle, and is provided with automatic stops allowing the square to be instantly set at 30° , 45° , 60° and 90° , without stopping to read or clamp the protractor.

ARCHITECTURAL AND STRUCTURAL PROTRACTOR. Special graduations are added to this protractor giving one-fifth, one-fourth and one-third roof pitches each way from zero, also special graduations to give two inches to the foot each way from zero.

CIVIL ENGINEERS' PROTRACTOR. This protractor has two independent swinging motions, the same as on a transit. The protractor is graduated to one-half degrees and the vernier reads to minutes. With the aid of this protractor it is a simple matter to duplicate work (done in the field) on the drawing, directly from the field notes.

HARDENED JOINT AND SOLID ROD DRAFTING MACHINES

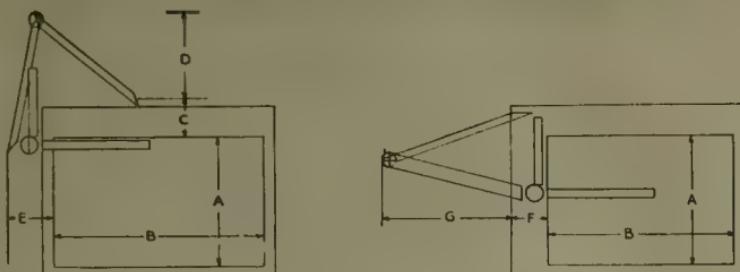
The Hardened Joint Solid Rod Drafting Machine is a development from the original construction of the Drafting Machine. Hardened, ground and polished straight cylindrical pins working in hardened, ground and polished bearings form the bearings of this machine, and it kept properly lubricated and free from dirt they will give many years of good service with no perceptible wear.

BALL BEARING TUBULAR ROD DRAFTING MACHINES

The Ball Bearing Tubular Rod Drafting Machine is an achievement that makes the Drafting Machine practically ideal. It has absolutely no play in the bearings and is frictionless. It is light in weight and possesses great rigidity, and is exceedingly accurate, and the motion is smooth and light.

Complete booklet fully describing Universal Drafting Machines and accessories mailed on application.

THE UNIVERSAL DRAFTING MACHINE



CAPACITIES AND CLEARANCES

Mid-Anchor Form

Size Length of Rods	Max. Clearance for extreme corner position only					Size Length of Rods	Max. Clearance for extreme corner position only				
	Rated Capacity	Maximum Capacity	A	B	C	D	E	A	B	C	D
18	20	30	24	36	6"	12"	7"	18	24	20	30
21	24	36	27	45	7"	14"	7"	21	20	30	32
24	30	42	30	52	8"	16"	7"	24	24	36	38
28	36	50	36	60	9"	19"	7"	28	30	42	45
32	40	60	40	70	10"	22"	7"	32	32	48	51
36	47	60	48	78	12"	24"	7"	36	36	54	60

Corner Anchor Form

Size Length of Rods	Max. Clearance for extreme corner position only				
	A	B	C	D	E
18	24	20	30	7"	18"
21	30	24	32	7"	21"
24	36	32	45	7"	24"
28	42	32	45	7"	28"
32	48	36	51	7"	32"
36	54	40	60	7"	36"

PRICE LIST

HARDENED JOINT AND SOLID ROD DRAFTING MACHINES

Prices of Machine only, without scales

Standard Protractor	Architect's Protractor	Civil Engineer's Protractor
---------------------	------------------------	-----------------------------

- Mid-Anchor, sizes 18, 21, 24 or 28
- Corner Anchor, sizes 18, 21, 24 or 28
- Mid-Anchor, sizes 32 and 36
- Corner Anchor, sizes 32 and 36

BALL BEARING TUBULAR ROD DRAFTING MACHINES

Prices of Machine only, without scales.

Standard Protractor	Architect's Protractor	Civil Engineer's Protractor
---------------------	------------------------	-----------------------------

- Mid-Anchor, sizes 18, 21, 24 or 28
- Corner Anchor, sizes 18, 21, 24 or 28
- Mid-Anchor, sizes 32 and 36
- Corner Anchor, sizes 32 and 36

Standard or Architect's Protractor, with vernier to 5 minutes, extra.....

THE JUNIOR DRAFTING MACHINE

Working Capacity 18x24"

Price without scales.

- Mid-Anchor, Standard Protractor.....
- Corner Anchor, Standard Protractor.....

FLAT WHITE-EDGE SCALES WITH CHUCKING PLATES FOR U. D. MACHINES

- 24 in. 12 in.
- 18 in. 6 in.

When ordering, state length of scales wanted and order graduation by the following numbers: No. 1, 3x1½"-¾x¾"; No. 2, 1x1½"-¾x½"; No. 3, full and half; No. 4, 10x50; No. 5, 20x40; No. 6, 30x60"; No. 7, 3x1½"; No. 8, ¾x¾"; No. 9, 1x½"; No. 10, ¼x½"; No. 11, MMx½MM; No. 12, 1 : 1x1 : 2; No. 13, 1 : 5x1 : 10; No. 14, 1 : 15x1 : 25.

STRAIGHTEDGES WITH CHUCKING PLATES FOR U. D. MACHINES

Ebony Lined Amber Lined

- 12 in.
- 18 in.
- 24 in.

See price list in back of catalog.

DRAFTSMEN'S SCALES

Alco Quality

We offer two types of scales: the Plain Boxwood and the White Edge, the latter a combination of boxwood and celluloid. Both are made of the finest materials and the wood is thoroughly seasoned. They are engine divided to United States standard measurements and the graduations are fine and clear and deeply cut. Both the Boxwood and the White Edge Scales are made in a variety of shapes, described as follows:



Triangular Scales, Regular Shape. This type of scale has the advantage of possessing six surfaces and affords the greatest range of scales.



Triangular Scales, Improved Shape. Like the regular shape, possesses six surfaces, but the concaved facet shape affords a better contact with the drawing and allows a better angle of vision. It prevents the divisions from wearing off by friction.



Flat Scales, Regular Shape. The regular shape flat scales have two bevels for graduations. The graduations are more conveniently read than on the triangular scales.



Flat Scales, Double Bevel. These scales have four bevels for graduations, but this shape necessitates the raising of the scale to bring the edge in close contact with the paper.



Flat Scales, Opposite Bevel. This type of scale is an improvement on the regular flat scale as it presents but one graduated bevel to the eye. It is easily picked up or turned.

DRAFTSMEN'S SCALES

Alec Quality

SCALES MADE TO ORDER

We are equipped to furnish special scales of all kinds, and in order to avoid mistakes or delay in prolonged corresponding we offer the following suggestions when ordering special scales:

- 1—State whether Boxwood or White Edge Scale is wanted.
- 2—State shape scale is to be. (See page 352.)
- 3—State length of scale wanted.
- 4—How each edge is to be graduated. State whether to be Open Divided or Full Divided.

There are two distinctly different ways of graduating a scale: the Open Divided and the Full Divided Scale.

The Open Divided Scales are generally used for architectural or mechanical drawing and are divided in inches or parts of inches, which represent feet or full inches. The units are graduated along the entire length and the end units only are subdivided to inches or fractions.

When ordering a scale divided with different divisions, two to each edge, one of these must be the double of the other, as, for instance, $\frac{1}{2} \times 1$, $1\frac{1}{2} \times 3$ or $\frac{1}{8} \times \frac{1}{4}$. One of the divisions on each edge is then numbered from the right and one from the left. On an open divided scale with but one division to each edge, each scale is ordinarily numbered reading from right to left and from left to right, and each end unit is subdivided to inches or fractions.

We can furnish the above scales, fully divided, to order if desired.

The Full Divided Scales, or Chain Scales, as they are commonly called, are used mostly by surveyors or civil engineers. They are generally divided to decimals of inches or feet, and subdivided the entire length of the scale. Therefore it is possible to have only one division to each edge. They are usually numbered continuous every ten divisions, the triangular scales reading from left to right and the flat scales reading both ways, i. e., from left to right and from right to left.

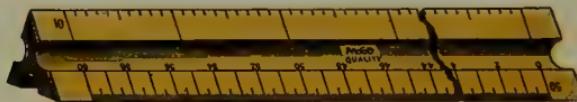
5—State how each edge is to be numbered, from left to right or right to left or both ways.

It is advisable when ordering special scales to furnish us a sketch. This need not be accurate. All that is necessary is to show the divisions as you want them, the length of the various graduation marks, and the numbering as it is wanted.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

TRIANGULAR BOXWOOD SCALES

Machine Divided
Regular Shape



Graduated 10, 20, 30, 40, 50 and 60 parts to the inch.

Each

No. 2301. 6 in.

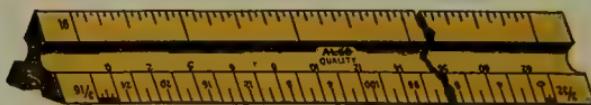
No. 2302. 12 in.

Graduated 20, 30, 40, 50, 60, 80 parts to the inch.

No. 2307. 12 in.

Graduated 100, 200, 300, 400, 500, 600 parts to the foot.

No. 2312. 12 in.



Graduated 3/32, 3/16, 1/8, 1/4, 3/8, 1/2, 3/4, 1, 1 1/2 and 3 inches to foot.

One edge 16 to the inch.

Each

No. 2321. 6 in.

No. 2322. 12 in.

Graduated 1/8, 1/4, 1/2, 1, 3/8, 3/4, 1 1/2, 2, 3 and 4 inches to foot.

One edge 16 to the inch.

No. 2327. 12 in.

Graduated 1/8, 1/4, 3/8, 1/2, 1, 1 1/2, 3 inches to the foot. One edge 50 parts to the inch and one edge 16 to the inch.

Each

No. 2332D. 12 in.

See price list in back of catalog.

TRIANGULAR WHITE-EDGE SCALES

Machine Divided

Regular Shape



Graduated 10, 20, 30, 40, 50, 60 parts to the inch.

No. 2341. 6 in. Each

No. 2342. 12 in.

No. 2344. 24 in.

Graduated 20, 30, 40, 50, 60, 80 parts to the inch.

No. 2347. 12 in.

Graduated 100, 200, 300, 400, 500, 600 parts to the foot.

No. 2352. 12 in.



Graduated $\frac{3}{32}$, $\frac{3}{16}$, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{5}{8}$, $\frac{1}{2}$, 1, $1\frac{1}{2}$ and 3 inches to foot.

One edge 16 to the inch.

No. 2361. 6 in. Each

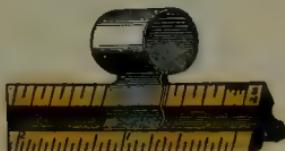
No. 2362. 12 in.

Graduated $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, $\frac{1}{8}$, $\frac{3}{4}$, $1\frac{1}{2}$, 2, 3 and 4 inches to foot.

One edge 16 to the inch.

No. 2367. 12 in.

SCALE GUARDS



No. 2370

No. 2370. Metal Guards for Triangular Scales Each

SHEATHS FOR TRIANGULAR SCALES

Made of heavy cardboard, velvet lined.

Length of Scale, inches—

6 12 18 24

No. 2371. For Regular Shape Scales.....

No. 2372. For Improved Shape Scales.....

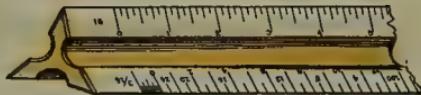
See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

TRIANGULAR SCALES—IMPROVED SHAPE

Machine Divided

BOXWOOD



Graduated 10, 20, 30, 40, 50 and 60 parts to the inch. Each

No. 2302X. 12 in.

Graduated 20, 30, 40, 50, 60, 80 parts to the inch.

No. 2307X. 12 in.

Graduated $\frac{3}{32}$, $\frac{3}{16}$, $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{3}{4}$, 1, $1\frac{1}{2}$ and 3 inches to the foot.

One edge 16 to the inch.

No. 2322X. 12 in.

Graduated $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, $\frac{3}{8}$, $\frac{3}{16}$, $1\frac{1}{2}$, 2, 3 and 4 inches to the foot.

One edge 16 to the inch.

No. 2327X. 12 in.

WHITE-EDGE



Graduated 10, 20, 30, 40, 50, 60 parts to the inch. Each

No. 2341X. 6 in.

No. 2342X. 12 in.

No. 2343X. 18 in.

No. 2344X. 24 in.

Graduated 20, 30, 40, 50, 60, 80 parts to the inch.

No. 2347X. 12 in.

Graduated 100, 200, 300, 400, 500, 600 parts to the foot.

No. 2352X. 12 in.

Graduated $\frac{3}{32}$, $\frac{3}{16}$, $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, 1, $1\frac{1}{2}$ and 3 inches to foot.

One edge 16 to the inch.

No. 2361X. 6 in.

No. 2362X. 12 in.

No. 2363X. 18 in.

No. 2364X. 24 in.

Graduated $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, $\frac{3}{8}$, $\frac{3}{16}$, $1\frac{1}{2}$, 2, 3 and 4 inches to foot.

One edge 16 to the inch.

No. 2367X. 12 in.

No. 2368X. 18 in.

No. 2369X. 24 in.

See price list in back of catalog.

MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS THE A. LIETZ COMPANY
SAN FRANCISCO, U. S. A.

METRIC SCALES

TRIANGULAR BOXWOOD, REGULAR SHAPE

No. 2380.	20 cm. long, div. .01, .02, .03, .05, .025, .0125.....	Each
No. 2381.	30 cm. long, div. .01, .02, .03, .05, .025, .0125.....	
No. 2382.	50 cm. long, div. .01, .02, .03, .05, .025, .0125.....	

Improved Shape made to order only.

TRIANGULAR WHITE-EDGE, REGULAR SHAPE

No. 2385.	20 cm. long, div. .01, .02, .03, .05, .025, .0125.....	Each
No. 2386.	30 cm. long, div. .01, .02, .03, .05, .025, .0125.....	
No. 2387.	50 cm. long, div. .01, .02, .03, .05, .025, .0125.....	

Improved Shape made to order only.

FLAT BOXWOOD METRIC SCALES

No. 2390.	10 cm. long, div. mm. and half mm.....	Each
No. 2391.	20 cm. long, div. mm. and half mm.....	
No. 2392.	30 cm. long, div. mm. and half mm.....	
No. 2393.	50 cm. long, div. mm. and half mm.....	

FLAT WHITE-EDGE METRIC SCALES

No. 2395.	10 cm. long, div. mm. and half mm.....	Each
No. 2396.	20 cm. long, div. mm. and half mm.....	
No. 2397.	30 cm. long, div. mm. and half mm.....	
No. 2398.	50 cm. long, div. mm. and half mm.....	

METRIC SCALES IN SETS

In neat polished mahogany case.

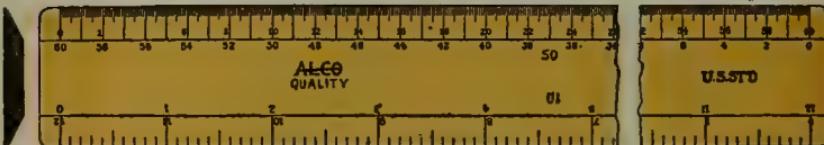
No. 2400.	Set of 6 Boxwood Scales 30 cm. long, divided metric .01, .02, .03, .05, .025, .0125. Set.....
No. 2401.	Set of 6 Boxwood Scales 50 cm. long, divided metric .01, .02, .03, .05, .025, .0125. Set.....
No. 2402.	Set of 6 White-Edge Scales 30 cm. long, divided metric .01, .02, .03, .05, .025, .0125. Set.....
No. 2403.	Set of 6 White-Edge Scales 50 cm. long, divided metric .01, .02, .03, .05, .025, .0125. Set.....

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

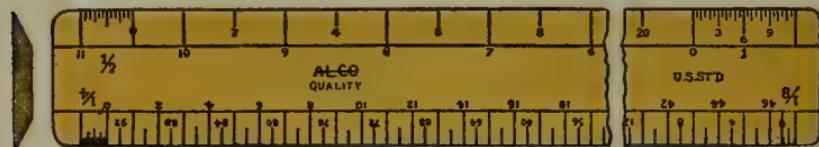
FLAT BOXWOOD SCALES

Machine Divided
REGULAR SHAPE



Divided inches and 10ths.

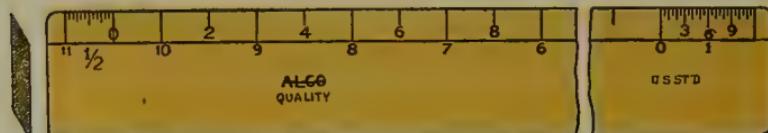
	Each
No. 2410—6 in.	10x50 parts to inch.
No. 2412—6 in.	20x40 parts to inch.
No. 2413—6 in.	30x60 parts to inch.
No. 2415—12 in.	10x50 parts to inch.
No. 2417—12 in.	20x40 parts to inch.
No. 2418—12 in.	30x60 parts to inch.



Graduated $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$ and 1 inch to the foot.

	Each
No. 2440—6 in.	.....
No. 2441—12 in.	.....
	Graduated $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$ and 3 inches to foot.
No. 2447—12 in.	.....

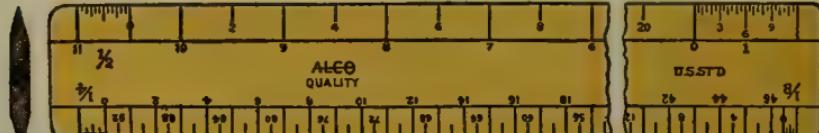
OPPOSITE BEVEL SHAPE



Graduated $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$ and 1 inch to the foot.

	Each
No. 2451—12 in.

DOUBLE BEVEL SHAPE



Graduated $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, $1 \times \frac{3}{8}$, $\frac{3}{4}$, $1\frac{1}{2}$ and 3 inches to the foot.

	Each
No. 2461—12 in.

See price list in back of catalog.

FLAT BOXWOOD SCALES

Machine Divided

Regular Shape

SCALE OF PROPORTIONAL INCHES

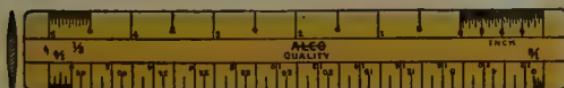
Flat Boxwood, Opposite Bevel Shape

No. 2479. 12 in. Each

Scale No. 2479 is graduated $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$ and full size in inches, two scales on each edge, and the unit beyond the zero point is subdivided.

FLAT BOXWOOD POCKET SCALES

Double Bevel Shape



In Leather Sheath, $\frac{3}{4}$ in. wide.

No. 2480. 6 in., divided 10, 40, 30 and 50 parts to inch. Each

No. 2481. 6 in., divided $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, $\frac{3}{8}$, $\frac{3}{4}$, $1\frac{1}{2}$ and 3 inches to the foot

FLAT METAL SCALES

Spring-tempered Steel Rules, one edge beveled. Engine divided. Approximate thickness $\frac{3}{64}$ inch.



No. 2487. 12-in., graduated 16ths, 32nds, 64ths and 100ths. (100ths on beveled edge.) Each



This rule has a very wide range of graduations, both English and metric. Not beveled.

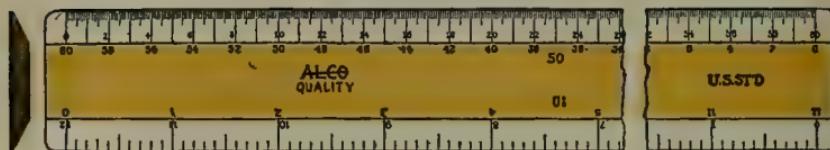
No. 2488. 12 in., marked both sides. One side, upper edge, 16ths, 32nds, 64ths; lower edge 10ths, 20ths, 50ths and 100ths inches; other side, upper edge millimeters, lower edge half-millimeters. Each

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

FLAT WHITE-EDGE SCALES

REGULAR SHAPE



Divided inches and 10ths.

Each

No. 2510.	6 in.	10x50 parts to inch.....
No. 2512.	6 in.	20x40 parts to inch.....
No. 2513.	6 in.	30x60 parts to inch.....
No. 2514.	6 in.	80x100 parts to inch.....
No. 2515.	12 in.	10x50 parts to inch.....
No. 2517.	12 in.	20x40 parts to inch.....
No. 2518.	12 in.	30x60 parts to inch.....
No. 2519.	12 in.	80x100 parts to inch.....

Divided feet in 100ths.

No. 2520.	12 in.	100x500 parts to foot.....
No. 2521.	12 in.	200x400 parts to foot.....
No. 2522.	12 in.	300x600 parts to foot.....
No. 2523.	12 in.	800x1000 parts to foot.....

OPPOSITE BEVEL SHAPE



Divided inches and 10ths.

Each

No. 2530.	12 in.	10x50 parts to inch.....
No. 2531.	12 in.	20x40 parts to inch.....
No. 2532.	12 in.	30x60 parts to inch.....
No. 2533.	12 in.	80x100 parts to inch.....

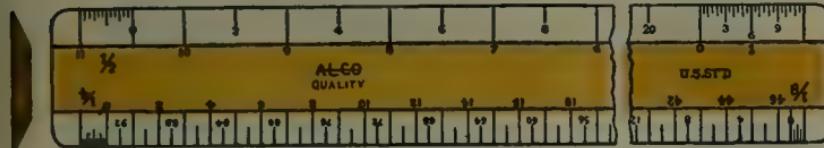
See price list in back of catalog.

MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS THE A. LIETZ COMPANY
SAN FRANCISCO, U. S. A.

FLAT WHITE-EDGE SCALES

Machine Divided

Regular Shape



Graduated $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, and 1 inch to the foot.

No. 2542 reads 100 feet on $\frac{1}{8}$, 50 feet on $\frac{1}{4}$ and 25 feet on $\frac{1}{2}$ inch.

Each

No. 2540. 6 in.

No. 2541. 12 in.

No. 2542. 12 $\frac{1}{2}$ in.

No. 2544. 24 in.

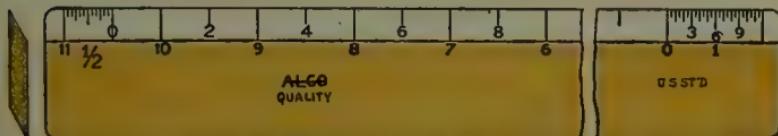
Graduated $\frac{1}{8}$, $\frac{1}{4}$, $1\frac{1}{2}$ and 3 inches to the foot.

No. 2546. 6 in.

No. 2547. 12 in.

No. 2549. 24 in.

OPPOSITE BEVEL SHAPE

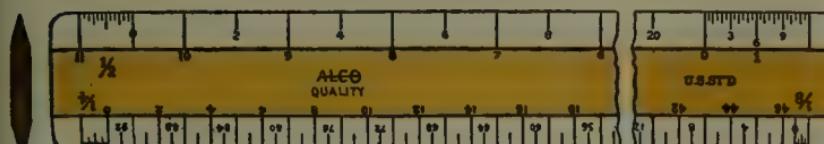


Graduated $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, and 1 inch to the foot.

Each

No. 2551. 12 in.

DOUBLE BEVEL SHAPE



Graduated $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2} \times 1$, $\frac{3}{8}$, $\frac{3}{4}$, $1\frac{1}{2}$ and 3 inches to the foot.

Each

No. 2561. 12 in.

No. 2563. 24 in.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

FLAT WHITE-EDGE SCALES

Machine Divided
Regular Shape

MISCELLANEOUS DIVISIONS

		Each
No. 2570.	12 in.	10x12 parts to inch.....
No. 2572.	12 in.	12x16 parts to inch.....
No. 2573.	12 in.	16x32 parts to inch.....
No. 2574.	12 in.	32x64 parts to inch.....
No. 2575.	12 in.	330x660 parts to inch.....
No. 2576.	6 in., divided 16ths in. and millimeters.....	
No. 2577.	12 in., divided 16ths in. and millimeters.....	

Divided Inch to the Mile

	Each
No. 2578M.	12 in., divided 1 in. to mile x 2 in. to mile.....
No. 2579M.	12 in., divided 8 in. to mile x 16 in. to mile.....

FLAT WHITE-EDGE POCKET SCALES

Double Bevel Shape



In Leather Sheath, $\frac{3}{4}$ in. wide.

	Each
No. 2580.	6 in., divided 10, 40, 30 and 50 parts to inch.....
No. 2581.	6 in., divided $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, $1\frac{1}{8}$, $3\frac{1}{4}$, $1\frac{1}{2}$, 3 inches to the foot..

DIAMETER AND CIRCUMFERENCE SCALE

Regular Shape



	Each
No. 2584.	12 in., divided for diameter and circumference.....

The divisions on this scale are in the ratio of diameter to circumference of a circle; one edge is divided in inches to 32nds, the other to spaces 3.1416 in. to 128ths.

See price list in back of catalog.

FLAT BOXWOOD SCALES IN SETS

In partitioned mahogany boxes, highly polished and well made.

**OPEN DIVIDED SCALES**

These Scales have the same divisions on both edges, one edge reading from left to right, the other edge from right to left.

- No. 2604.** Set of 4 Boxwood Scales, 12 in., divided $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1 in. to the foot. Per set.....
- No. 2608.** Set of 8 Boxwood Scales, 12 in., divided $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, $\frac{3}{8}$, $\frac{3}{4}$, $1\frac{1}{2}$, 3 in. to the foot. Per set.....
- No. 2612.** Set of 12 Boxwood Scales, 12 in., divided $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, $\frac{3}{8}$, $\frac{3}{4}$, $1\frac{1}{2}$, 2, 3, 4, 6, 12 in. to the foot. Per set.....

FULL DIVIDED OR CHAIN SCALES

The Scales contained in set No. 2624 have two different divisions, one on each edge, each of which is numbered to read both ways.

- No. 2624.** Set of 4 Boxwood Scales, 12 in., divided 10, 20, 30, 40, 50, 60, 80, 100 parts to the inch. Per set.....

The Scales contained in sets Nos. 2626 and 2628 have the same division on both edges and are numbered to read both ways on each edge.

- No. 2626.** Set of 6 Boxwood Scales, 12 in., divided 10, 20, 30, 40, 50, 60 parts to the inch. Per set.....
- No. 2628.** Set of 8 Boxwood Scales, 12 in., divided 10, 20, 30, 40, 50, 60, 80, 100 parts to the inch. Per set.....

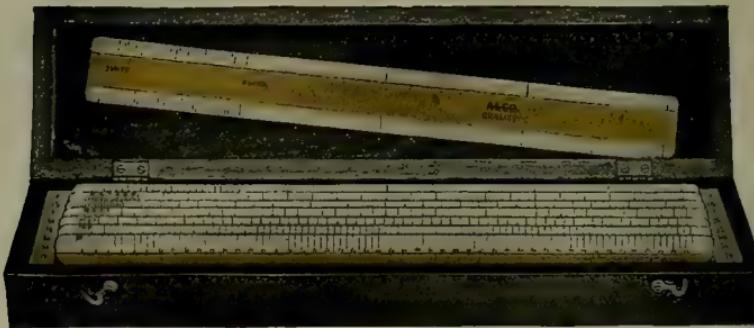
Metric Scales in sets, see page 357.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

FLAT WHITE-EDGE SCALES IN SETS

In partitioned mahogany boxes, highly polished and well made.



OPEN DIVIDED SCALES

These Scales have the same division on both edges, one edge reading from left to right, the other edge from right to left.

- No. 2634. Set of 4 White-Edge Scales, 12 in., divided $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1 in. to the foot.
No. 2638. Set of 8 White-Edge Scales, 12 in., divided $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, $\frac{3}{8}$, $\frac{3}{4}$, $1\frac{1}{2}$, 3 in. to the foot.
No. 2642. Set of 12 White-Edge Scales, 12 in., divided $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, $\frac{3}{8}$, $\frac{3}{4}$, $1\frac{1}{2}$, 2, 3, 4, 6, 12 in. to the foot.

FULL DIVIDED OR CHAIN SCALES

The Scales contained in set No. 2654 have two different divisions, one on each edge, each of which is numbered to read both ways.

- No. 2654. Set of 4 White-Edge Scales, divided 10, 20, 30, 40, 50, 60, 80, 100 parts to the inch.

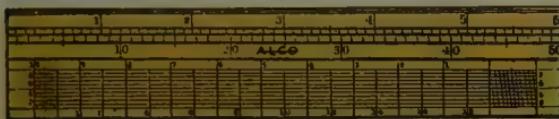
The Scales contained in sets Nos. 2656 and 2658 have the same division on both edges, and are numbered to read both ways on each edge.

- No. 2656. Set of 6 White-Edge Scales, divided 10, 20, 30, 40, 50, 60 parts to the inch.
No. 2658. Set of 8 White-Edge Scales, divided 10, 20, 30, 40, 50, 60, 80, 100 parts to the inch.

Metric Scales in sets, see page 357.

See price list in back of catalog.

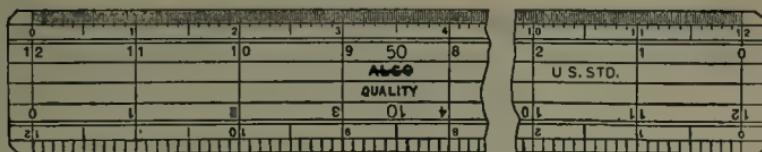
PLOTTING SCALES



Each

- No. 2660. Boxwood Plotting Scale, 6 in.....

TRANSPARENT AMBER UNDERWRITERS' SCALES
Regular Shape



Nos. 2663-2664

Each

- No. 2663. Flat Transparent Amber Underwriters' Scale, 6 in., divided 10x50 parts to inch.....

- No. 2664. Same as No. 2663, but 12 in.....

PAPER SCALES

Printed on Bristol Board, engine divided.



- No. 2665. Cardboard Scales, 18 in. long, full divided in either $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{3}{4}$, 1, $1\frac{1}{2}$, or 3 inches to the foot. Per set of these 8 scales

Single Scales. Each.....

- No. 2666. Cardboard Scales, 18 in. long, full divided in either 10, 20, 30, 40, 50, or 60 parts to the inch. Per set of these 6 scales. Single Scales. Each.....

- No. 2667. Metric Paper Scales, $\frac{1}{2}$ meter long, divided in mm. Each.

- No. 2668. Metric and inch comparing Scale, $\frac{1}{2}$ meter long. Each....

- No. 2669. Scale of proportional inches, 12 in. long, divided $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$ and 1 inch. Each

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

WOOD DESK RULERS

Made of Rock Maple in natural color, finely varnished.



Graduated inches and 16ths.

12-in. 15-in. 18-in.

No. 2670. Maple, plain edges.....

No. 2672. Maple, 2 inlaid brass edges.....

SCHOOL RULERS

Made of Rock Maple in natural color, varnished.



Graduated inches and 16ths.

Doz. Each

No. 2674. Maple, plain edges, 12 in.....

YARD STICKS

Polished.



Nos. 2676-77

Graduated one side inches and 8ths, other side fractions of yards.

No. 2676. Maple, plain, 1x1/4 in. Each.....

No. 2677. Maple, brass tipped, 1x1/4 in. Each.....

METER STICKS

Polished.



No. 2679

Graduated both sides, one edge only; one side inches and 8ths, other side to millimeters.

No. 2679. Maple, brass tipped, 1x5/16 in. Each

See price list in back of catalog.

CLINOMETER RULE

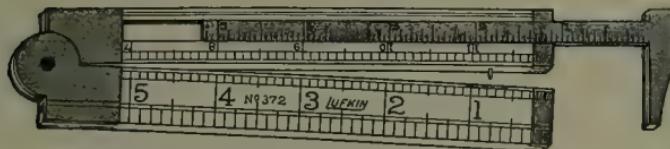
12 Inch. Two fold.



No. 2680

No. 2680. Clinometer Rule, boxwood, full bound, combines carpenter's rule, spirit level, inclinometer or slope level, square, plumb, drafting scale, brace scale, T square, and protractor. Each.....

BOXWOOD CALIPER RULES



No. 2686

No. 2685. 6 in., 2 fold, unbound; graduated 8, 10, 12 and 16ths. Each.....

No. 2686. 1 ft., 2 fold, unbound; graduated 8, 10, 12 and 16ths. Each.....

No. 2687. 2 ft., 4 fold, full bound; graduated 8, 10, 12 and 16ths. Each.....

EXTENSION RULES



Used in measuring between fixed points such as floor and ceiling, across large openings, etc. Made of maple, with sections 1 inch wide, $\frac{3}{8}$ inch thick. Clamps and end plates are brass plated. The rules are fitted with tension spring and set screw, securely holding the sections when closed or extended to any distance. They have stop at both ends so sections cannot fall apart.

In Two Sections, with Set Screws

Fitted with steel springs to keep the sliding joints at any desired point. Graduated feet, inches and 8ths.

No. 2702. 2 ft., extending to 4 ft. Each.....

No. 2703. 3 ft., extending to 6 ft. Each.....

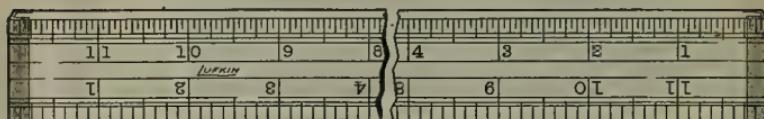
No. 2704. 4 ft., extending to 8 ft. Each.....

No. 2706. 6 ft., extending to 12 ft. Each.....

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

MANUAL TRAINING RULES

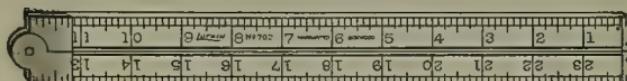


No. 2710

Handy one-foot, one-piece rules that are especially popular in the manual training and vocational school fields.

Marked both sides, both edges; one edge 8ths, other edge 16ths inch.

No. 2710. Maple, brass capped, $1\frac{1}{8} \times 3/16$ in. Each.....



No. 2712

Two-foot, two-fold, unbound. Marked 8ths and 16ths inch.

This is the medium priced rule in 12-inch sections; a type that is widely used in manual training and vocational school work.

No. 2712. Boxwood, 2-foot, 2-fold; unbound, $1\frac{3}{8}$ in. wide. Each....

ARCHITECTS' RULES

With inside edges beveled.

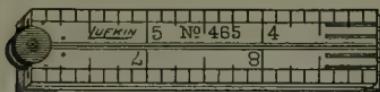


No. 2721

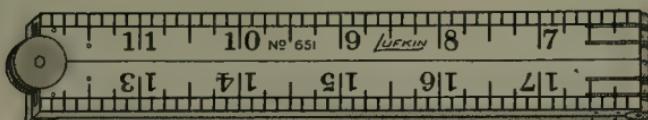
No. 2720. Boxwood, 2-foot, 4-fold, graduated 8, 10, 12 and 16ths, with drafting scales. Each.....

No. 2721. Ivory, 2-foot, 4-fold, graduated 8, 10, 12 and 16ths, with drafting scales. Each

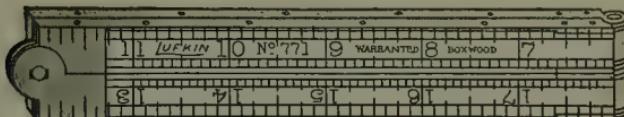
See price list in back of catalog.

ONE-FOOT BOXWOOD RULES**Unbound. Four Fold**

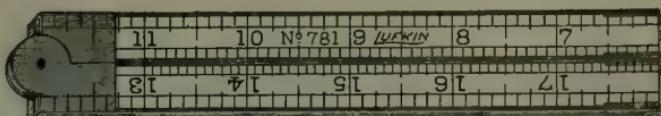
- No. 2725.** 1 ft., 4 fold, $\frac{5}{8}$ in. wide, unbound; graduated 8ths and 16ths.
Each

TWO-FOOT BOXWOOD RULES**Unbound. Four Fold**

- No. 2726.** 2 ft., 4 fold, 1 in. wide, unbound; graduated 8ths and 16ths.
Each

Half Bound. Four Fold

- No. 2727.** 2 ft., 4 fold, 1 in. wide, half bound; graduated 8, 10, 12 and
16ths. Each

Full Bound. Four Fold

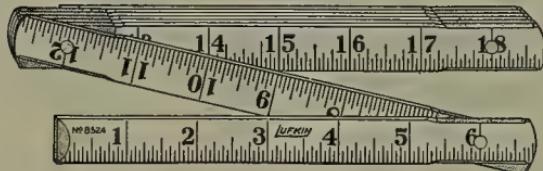
- No. 2728.** 2 ft., 4 fold, 1 in. wide, full bound; graduated 8, 10, 12 and
16ths. Each

- No. 2728 1/2.** Same as No. 2728, graduated 10ths and 100ths of a foot,
and 10ths and 16ths of inches. Each.....

See price list in back of catalog.

FLEXIBLE SPRING JOINT RULES

Hardwood, Yellow and White Finish, $\frac{5}{8}$ In. Wide



These Pocket Rules are thin and light, and provided with spring joints so that they may be held in a straight line when open. They are made of strong material, and heavily coated, and the ends are provided with metal tips.

Yellow Enamel.

White Enamel.

Marked consecutive inches, divided in 16ths.

No. 2732.	2 ft. Each.....	No. 2732W.	2 ft. Each.....
No. 2733.	3 ft. Each.....	No. 2733W.	3 ft. Each.....
No. 2734.	4 ft. Each.....	No. 2734W.	4 ft. Each.....
No. 2735.	5 ft. Each.....	No. 2735W.	5 ft. Each.....
No. 2736.	6 ft. Each.....	No. 2736W.	6 ft. Each.....
No. 2738.	8 ft. Each.....	No. 2738W.	8 ft. Each.....

Marked feet and inches, divided in 16ths.

No. 2743.	3 ft. Each.....	No. 2743W.	3 ft. Each.....
No. 2744.	4 ft. Each.....	No. 2744W.	4 ft. Each.....
No. 2745.	5 ft. Each.....	No. 2745W.	5 ft. Each.....
No. 2746.	6 ft. Each.....	No. 2746W.	6 ft. Each.....
No. 2748.	8 ft. Each.....	No. 2748W.	8 ft. Each.....

Marked feet and inches one side, feet, 10ths and 100ths other side.

No. 2754.	4 ft. Each.....	No. 2754W.	4 ft. Each.....
No. 2755.	5 ft. Each.....	No. 2755W.	5 ft. Each.....
No. 2756.	6 ft. Each.....	No. 2756W.	6 ft. Each.....

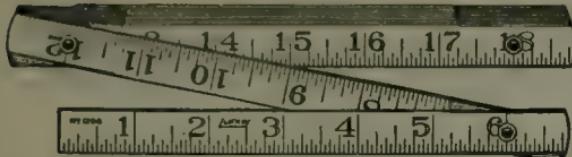
Marked consecutive inches one side, metric to millimeters other side.

No. 2762.	2 ft. Each.....	No. 2762W.	2 ft. Each.....
No. 2763.	3 ft. Each.....	No. 2763W.	3 ft. Each.....
No. 2764.	4 ft. Each.....	No. 2764W.	4 ft. Each.....
No. 2766.	6 ft. Each.....	No. 2766W.	6 ft. Each.....

See price list in back of catalog.

ALUMINUM RULES

Six-Inch Folds. 9/16-Inch Wide



num and having solid brass joints, rules are rust-proof throughout. The surface of rule is in natural color, with sunken graduations and figures in black showing up distinctly.

Marked Consecutive Inches to 16ths, Both Sides.

- | | | |
|-----------|-------|-----------|
| No. 2793. | 3 ft. | Each..... |
| No. 2794. | 4 ft. | Each..... |
| No. 2796. | 6 ft. | Each..... |

FOLDING FLEXIBLE STEEL POCKET RULES

With Patent Stop Joints



No. 2801

Three-eighths inch wide, flexible spring steel. Raised figures. With patent stop joints that hold rule true and rigid when extended.

Marked Consecutive Inches, divided in 16ths.

- | | | |
|-----------|---------------------|-----------|
| No. 2801. | 1 ft. 4 in. joints. | Each..... |
| No. 2802. | 2 ft. 4 in. joints. | Each..... |
| No. 2803. | 3 ft. 4 in. joints. | Each..... |

Marked Inches and 16ths one side, Feet, 10ths and 100ths other side.

- | | | |
|-----------|---------------------|-----------|
| No. 2811. | 1 ft. 4 in. joints. | Each..... |
| No. 2812. | 2 ft. 4 in. joints. | Each..... |
| No. 2813. | 3 ft. 4 in. joints. | Each..... |

Marked Inches and 16ths one side, Millimeters other side.

- | | | |
|-----------|---------------------|-----------|
| No. 2821. | 1 ft. 4 in. joints. | Each..... |
| No. 2822. | 2 ft. 4 in. joints. | Each..... |
| No. 2823. | 3 ft. 4 in. joints. | Each..... |

METAL BOUND LEATHER CASES FOR STEEL POCKET RULES



- | | | |
|-----------|--|-----------|
| No. 2831. | Leather Case for 1 ft. 4 in. joint rule. | Each..... |
| No. 2832. | Leather Case for 2 ft. 4 in. joint rule. | Each..... |
| No. 2833. | Leather Case for 3 ft. 4 in. joint rule. | Each..... |

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

PARALLEL RULES



Ebony, Nickel-Plated Bars

No. 2860.	6 in.	Each	.....
No. 2862.	12 in.	Each	.....
No. 2863.	15 in.	Each	.....
No. 2864.	18 in.	Each	.....
No. 2865.	24 in.	Each	.....

CAPTAIN FIELD'S IMPROVED PARALLEL RULER



No. 2890.	Captain Field's Parallel Ruler, 18 in.	.....
No. 2891.	Captain Field's Parallel Ruler, 24 in.	.....

LIETZ ROLLING PARALLEL RULES

Finest quality, made of brass, heavily nickel-plated. They are considerably heavier than the average rules. The greatest accuracy of motion is assured. Each rule packed in individual plain wooden box.



No. 2932.	12 in.	Each	.....
No. 2934.	18 in.	Each	.....
No. 2935.	24 in.	Each	.....

See price list in back of catalog.

SECTION LINERS



No. 2940

No. 2940. Practical Section Liner, hardwood with nickel-plated mountings and 7 in. Amber Rule, in imitation morocco case.....

Section Liner No. 2940 is strong, simple and durable. It retains its place on the board by means of pins in the bottom of the base. The range of work is great, allowing spaces from $1/100$ to $\frac{1}{2}$ inch at any angle without changing position.

REVERSIBLE SECTION LINER



No. 2948

No. 2948. Reversible Section Liner, hardwood with nickel-plated mountings and 7 in. amber rule, in imitation morocco case.....

No. 2949. Same as No. 2948 but with 15 in. amber rule.....

Section Liners Nos. 2948 and 2949 are called *Reversible* because they operate both from left to right and from right to left. The bar is stationary and the whole liner occupies but a space on the drawing board $8\frac{3}{4}$ in. long. The arm is perfectly rigid. An extra strong steel spring clutches the carriage firmly at any point along the bar, so that there is positively no lost motion in any of its parts, although the pinching together of either left or right post and the lever forces it evenly and smoothly forward the distance of the setting. In operating, let us say from left to right, bring the car, by means of pressure, to the left-hand end of the base. Set the left indicator to the desired spacing, clamp firmly. Place the forefinger of the left hand on the knurled knob, the thumb on the lever. Press together, releasing first forefinger, then the thumb. In reversing, or in this case, operating from right to left, set to the desired spacing, by means of the right-hand indicator, and proceed as before.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND SURVEYORS' INSTRUMENTS

SAN FRANCISCO, U. S. A.

SLIDE RULES

The Slide Rule is an indispensable aid to anyone who in his business is called upon to make calculations. The principles with which one must be familiar are few and simple and are easily mastered with little practice.

Abstract from Kent's Mechanical Engineers' Pocket Book, 9th Edition, 1916.

The slide rule is based on the principles that the addition of logarithms multiplies the numbers which they represent, and subtracting logarithms divides the numbers. By its use the operations of multiplication, division, the finding of powers and the extraction of roots, may be performed rapidly and with an approximation to accuracy which is sufficient for many purposes. With a good 10-inch Mannheim rule the results obtained are usually accurate to $\frac{1}{4}$ of 1 per cent. Much greater accuracy is obtained with cylindrical rules like the Thacher.

The rule consists of a fixed and a sliding part both of which are ruled with logarithmic scales; that is, with consecutive divisions spaced not equally, as in an ordinary scale, but in proportion to the logarithms of a series of numbers from 1 to 10. By moving the slide to the right or left the logarithms are added or subtracted, and multiplication or division of the numbers thereby effected. The scales on the fixed part of the rule are known as the *A* and *D* scales, and those on the slide as the *B* and *C* scales. *A* and *B* are the upper and *C* and *D* are the lower scales. The *A* and *B* scales are each divided into two, left hand and right hand, each being a reproduction, one half the size, of the *C* and *D* scales. A "runner," which consists of a framed glass plate with a fine vertical line on it, is used to facilitate some of the operations. The numbering on each scale begins with the figure 1, which is called the "index" of the scale. In using the scale the figures 1, 2, 3, etc., are to be taken either as representing these numbers, or as 10, 20, 30, etc., 100, 200, 300, etc., 0.1, 0.2, 0.3, etc., that is, the numbers multiplied or divided by 10, 100, etc., as may be most convenient for the solution of a given problem.

The following examples will give an idea of the method of using the slide rule:

Proportion.—Set the first term of a proportion on the *C* scale opposite the second term on the *D* scale, then opposite the third term on the *C* scale read the fourth term on the *D* scale.

EXAMPLE.—Find the fourth term in the proportion $12 : 21 :: 30 : x$. Move the slide to the right until 12 on *C* coincides with 21 on *D*, then opposite 30 on *C* read *x* on *D* = 52.5. The *A* and *B* scales may be used instead of *C* and *D*.

Multiplication.—Set the index or figure 1 of the *C* scale to one of the factors on *D*.

EXAMPLE.— 25×3 . Move the slide to the right until the left index of *C* coincides with 25 on the *D* scale. Under 3 on the *C* scale will be found the product on the *D* scale, = 75.

Division.—Place the divisor on *C* opposite the dividend on *D*, and the quotient will be found on *D* under the index of *C*.

EXAMPLE.— $750 \div 25$. Move the slide to the right until 25 on *C* coincides with 750 on *D*. Under the left index of *C* is found the quotient on *D*, = 30.

Combined Multiplication and Division.—Arrange the factors to be multiplied and divided in the form of a fraction, with one more factor in the numerator than in the denominator, supplying the factor 1 if necessary. Then perform alternate division and multiplication, using the runner to indicate the several partial results.

$$4 \times 5 \times 8$$

EXAMPLE.— $\frac{3 \times 6}{4 \times 8} = 8.9$ nearly. Set 3 on *C* over 4 on *D*, set runner to 5 on *C*, then

set 6 on *C* under the runner, and read under 8 on *C* the result 8.9—on *D*.

Involution and Evolution.—The numbers on scales *A* and *B* are the squares of their coinciding numbers on the scales *C* and *D*, and also the numbers on scales *C* and *D* are the square roots of their coinciding numbers on scales *A* and *B*.

EXAMPLE.— $4^2 = 16$. Set the runner over 4 on scale *D* and read 16 on *A*.

$\sqrt{16} = 4$. Set the runner over 16 on *A* and read 4 on *D*.

In extracting square roots, if the number of digits is odd, take the number of the left-hand scale of *A*; if the number of digits is even, take the number of the right-hand scale of *A*.

To cube a number, perform the operations of squaring and multiplication.

EXAMPLE.— $2^3 = 8$. Set the index of *C* over 2 on *D*, and above 2 on *B* read the result 8 on *A*.

Extraction of the Cube Root.—Set the runner over the number on *A*, then move the slide until there is found under the runner on *B* the same number which is found under the index of *C* on *D*; this number is the cube root desired.

EXAMPLE.— $\sqrt[3]{8} = 2$. Set the runner over 8 on *A*, move the slide along until the same number appears under the runner on *B* and under the index of *C* on *D*; this will be the number 2.

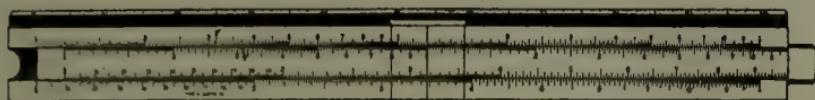
Trigonometrical Computations.—On the under side of the slide (which is reversible) are placed three scales, a scale of natural sines marked *S*, a scale of natural tangents marked *T*, and between these a scale of equal parts. To use these scales, reverse the slide, bringing its under side to the top. Coinciding with an angle on *S* its sine will be found on *A*, and coinciding with an angle on *T* will be found the tangent on *D*. Sines and tangents can be multiplied or divided like numbers.

See price list in back of catalog.

MANNHEIM SLIDE RULES

Best Quality

Adjustable



These Rules are engine divided on white celluloid facings. The divisions are clear, distinct, permanent and accurate.

Each

No. 2960. 5-inch Mannheim Rule in sewed leather case, with instructions. Each

No. 2960M. Same as No. 2960, but in morocco case.....

These rules are subdivided as closely as the 10-inch rule No. 2964.

No. 2964. 10-inch Mannheim Rule in morocco case, with instructions. Each

No. 2965. 10-inch Mannheim Rule, like No. 2964, but subdivided as closely as the 20-inch rule, in morocco case, with instructions. Each

No. 2967. 16-inch Mannheim Rule in morocco case, with instructions. Each

This rule is subdivided as closely as the 20-inch Rule No. 2969.

No. 2969. 20-inch Mannheim Rule in morocco case, with instructions. Each

Rules Nos. 2965, 2967 and 2969 have from 200 to 20 subdivisions between the prime numbers, while the shorter rules have from 100 to 10, therefore the reading is closer by at least one figure.

No. 3060H. Glass Indicator with two hairlines instead of one, add....

For complete line of Indicators, Instruction Books and Slide Rule Accessories see page 380.

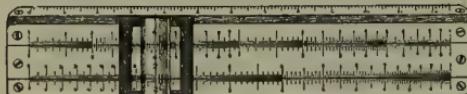
See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

MANNHEIM SLIDE RULES

Best Quality.

THE JUNIOR SLIDE RULE



No. 2970

Each

- No. 2970.** Junior Mannheim Slide Rule, 5 in. long, mahogany stock with white celluloid facings. Graduations engine divided, with magnifier. In sewed leather case with instructions.

The Junior Mannheim Slide Rule No. 2970 combines the accuracy of a regular 10-inch slide rule with the convenience afforded by its compactness. The subdivisions are as fine as those on a regular 10-inch rule, and by means of a neat but powerful magnifying glass attached to the indicator their value is easily ascertained with the same degree of accuracy as can be obtained on the larger rule.

THE VEST POCKET SLIDE RULES



Nos. 2972-73

Each

- No. 2972.** Alco Vest Pocket Slide Rule, 4 3/4 in. long, 3/4 in. wide, thin mahogany stock with white celluloid facings; engine divided, graduations are clear, distinct, permanent and accurate. Complete with indicator in sewed leather case.
Instruction book extra.

- No. 2973.** Vest Pocket Slide Rule, 5 in. long, thin mahogany stock with white celluloid facings. Narrow for pocket use. Complete with indicator, case and instructions.

- No. 2973L.** Same as No. 2973, but in sewed leather case.

ECONOMY SLIDE RULES



No. 2974

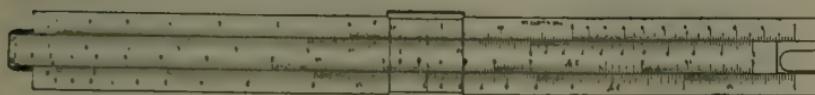
Each

- No. 2974.** Economy (Mannheim) Slide Rule, 10 inches long, divisions on white celluloid facings. Complete with indicator, case and instructions.

The Economy Slide Rule is of the same pattern as Mannheim Slide Rule No. 2964, but is not adjustable.

See price list in back of catalog.

STUDENTS' SLIDE RULE



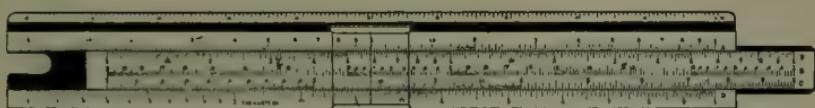
No. 2975

- No. 2975.** Students' (Mannheim) Slide Rule, 10 in., with transparent celluloid indicator. Engine divided on polished boxwood. Graduations clear and accurate. In case with instructions. Each.....
Students' Slide Rule No. 2975 is similar to our Economy Slide Rule No. 2974, but graduations are on polished boxwood instead of white celluloid.

THE POLYPHASE SLIDE RULE

Best Quality

Adjustable



The Polyphase Slide Rule has in addition to the regular scales of the Mannheim Rule a scale of cubes and an inverted scale through the center of the slide. These scales may be used in connection with the others, by means of the indicator. The inverted scale enables taking three factors at one setting of the slide, and reading reciprocals by means of the indicator. Almost any combination of three factors involving square, square root, cube and cube root may be solved at one setting of the slide.

Rules are engine divided on white celluloid facings. The divisions are clear, distinct, permanent and accurate.

- No. 2980.** 5-inch Polyphase Rule in sewed leather case, with instructions. Each
- No. 2980M.** Same as No. 2980, but in morocco case. Each.....
- No. 2984.** 10-inch Polyphase Rule in morocco case, with instructions. Each
- No. 2985.** 10-inch Polyphase Rule like No. 2984, but subdivided as closely as the 20-inch rule, in morocco case, with instructions. Each
- No. 2989.** 20-inch Polyphase Rule in morocco case, with instructions. Each

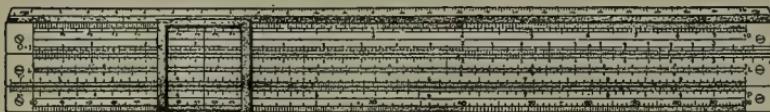
NOTICE

Owing to the large variety of Slide Rules now being offered for varied or special purposes, we have listed only such types as are widely used. We are in position to furnish any type of slide rule which may better suit the requirements of our trade.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

THE PRECISION SLIDE RULE



The Precision Slide Rules are similar to other Mannheim Slide Rules, but the results obtained are of a considerably greater accuracy. The increase in accuracy is obtained by making the scale length of the logarithmic unit equal to 20 inches instead of 5 or 10 inches. The scale is not, however, made in one length of 20 inches, but in two lengths of 10 inches each. All the other scales, including those on the back of the slide, are based on the scale length of 20 inches; so that all calculations with this slide rule have a uniform and considerably greater degree of accuracy than those made with the ordinary slide rule.

Rules are engine divided on white celluloid facings. The divisions are clear, distinct, permanent and accurate.

- No. 2994.** 10-inch Precision Slide Rule in morocco case, with instructions. Each

THE ALCO SLIDE RULE



This Slide Rule differs from those hitherto ordinarily employed in that it has on its front face not only the four middle scales (two on the rule A and D; and two on the slide B and C), but also two other scales, viz., an evenly divided scale E, on the lower margin, and a logarithmic scale F, at the top, the latter consisting of three similar scales, placed consecutively.

By this arrangement, logarithms, cubes and cube roots can be directly and easily determined. With the ordinary slide rules these calculations, especially the extraction of cube roots, are somewhat complicated, and necessitate the use of the slide.

All calculations such as multiplication, division, involution, evolution, etc., are carried out with the first mentioned scales, A, B, C, D.

Engine divided on white celluloid facings. The divisions are clear, distinct, permanent and accurate.

- No. 3024.** 10-inch Alco Slide Rule, in morocco case with instructions.
Each
- No. 3029.** 20-inch Alco Slide Rule, in morocco case with instructions.
Each

See price list in back of catalog.

THE ELECTRIC SLIDE RULE



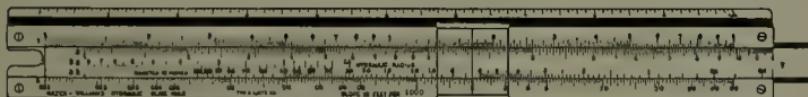
Especially evolved in response to a demand for a suitable Slide Rule for Electrical Engineers and for students in Electro-Technology.

Serves in an excellent manner the facility of calculation of all electro-technological problems. The table of constants, on the reverse of the rule, makes the reference to hand-books almost superfluous.

Engine divided on white celluloid facings. The divisions are clear, distinct, permanent and accurate.

No. 3034. 10-inch Electric Slide Rule, in morocco case, with directions.
Each

HAZEN-WILLIAMS HYDRAULIC SLIDE RULE



No. 3044

The Hazen-Williams Hydraulic Slide Rule is used principally for determining the velocity and quantity of the flow of water in pipes and channels, but is also adapted for ordinary slide rule calculations. Special computations may also be solved by its use, as, for instance, to determine the corresponding flow at any other slope or head, when the flow of water through a pipe or system of pipes produced by a given slope or head is known; to find what size of pipe must be used to produce the same discharge for any other slope, when the discharge in a given size of pipe at a given slope is known; to compute the discharge through a compound pipe, that is, a pipe of larger diameter connecting with a pipe of smaller diameter, or a series of such pipes; to compute the friction of a given amount of water flowing through two pipes of different diameters and different lengths, freely connected at each end; to get with one setting of the slide the quantity of water corresponding to any slope; to get with one setting of the slide the quantities of water discharged by pipes of different sizes for a given slope and coefficient. In size and general appearance the rule is like an ordinary Mannheim 10-inch slide rule. On the back of the rule are several tables to aid in the convenience of computations to which the rule is applicable. Engine divided on white celluloid facings. The divisions are clear, distinct, permanent and accurate.

No. 3044. 10-inch Hazen-Williams Hydraulic Slide Rule, in morocco case, with directions.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

SLIDE RULE ACCESSORIES



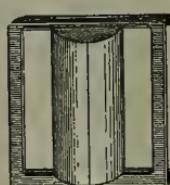
Frameless
Indicator



Indicator with
Aluminum Frame



No. 3071



No. 3072

INDICATORS

No. 3060A. For all 5 in. and vest pocket rules. Each.....

No. 3060B. For all 10 and 20-in. rules. Each.....

Be sure to specify the number of the rule for which indicator is desired and whether frameless type or indicator with frame is wanted.

GLASSES ONLY FOR FRAMELESS INDICATORS

No. 3062A. For Slide Rules up to and including 10 in. long, each....

No. 3062B. For Slide Rules over 10 in. long, each.....

MAGNIFIERS

No. 3070. Detachable Magnifier for Slide Rule Indicator. Each....
When ordering please specify for which Slide Rule the Magnifier is wanted.

No. 3071. Indicator with full-size Magnifier for slide rules. Each..

No. 3072. Indicator with half-size Magnifier for slide rules. Each..
When ordering please specify for which Slide Rule the Indicator is wanted.

CASES FOR SLIDE RULES

No. 3073. Morocco Case for Slide Rules.
Inches long— 5 10 16 20
Each

No. 3074A. Sewed Leather Case for Slide Rules.
Inches long— 5 10 16 20
Each

No. 3074B. Sewed Leather Case with space for Magnifier.
Inches long— 5 10 16 20
Each

BOOKS ON THE SLIDE RULE

BK1. Instructions in the use of Slide Rules. 55 pages with illustrations and complete instruction for all our slide rules. Each.....

BK2. Instructions for the use of the Slide Rules, published by A. W. Faber. Each

BK3. "The Use of the Slide Rule," by F. A. Halsey, Fourth Ed., 18 Ill., 7 folding plates. Each

BK4. "The Slide Rule," by Chas. N. Pickworth. A practical manual of instruction, 17th Ed., illustrated. Each

See price list in back of catalog.

THE IMPROVED HALDEN CALCULEX

2½ inches diameter by ¼ inch thick.



No. 3075

This is a very compact, convenient and accurate instrument and very simple to operate. It is made entirely of metal and its construction is extremely simple, so that it is impossible for the instrument to get out of order.

The book of rules accompanying each instrument is most extensive and complete, yet very clear and easy to understand. It has been arranged so as to fit in a separate compartment of the leather case containing the instrument, so that both together can be conveniently carried in the vest pocket.

The Calculex, briefly described, consists of a disc within a fixed ring, which together form a dial with logarithmic scales on both sides, surrounded by a metal ring and protected on both sides by a glass rim with an indicator hair line marked thereon.

The instrument is operated by turning the disc, holding the nut on either side between finger and thumb. The outside ring is fastened to the rim.

Logs of numbers, squares, square roots, cubes, cube roots, angles, can be read direct from the indicator line, without turning the disc.

The front face contains five circles of scales. The outer scale No. 1 is a scale of Logs; Nos. 2 and 3 are the calculating scales A and B, Nos. 4 and 5 are the square roots of B scale.

The reverse contains six circles of scales. The outer scale, No. 6, is a scale of angles, Nos. 7 and 8 are calculating scales for reverse proportions, Nos. 9, 10 and 11 are cube roots of scale B.

No. 3075. Halden Calculex Slide Rule, in leather case, with book of instructions. Each

No. 3075G. New Glass for Halden Calculex. Each

THE BOUCHER CALCULATOR

About 2 inches diameter by 9/16 inch thick.



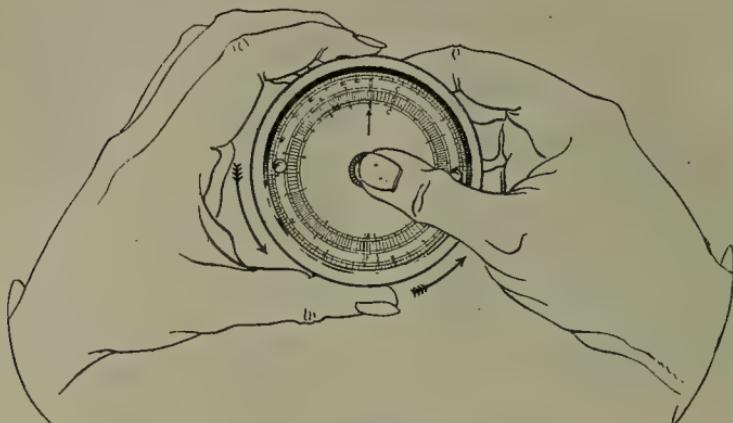
No. 3080

This instrument resembles an ordinary stem-winding watch, with glass-covered dials back and front. Ratios are set off by means of pointers, which, as well as the movable dial, are moved by means of the stem-winder key. Instrument of convenient size to carry in pocket.

No. 3080. Boucher Calculator, silvered metal dials. Each

See price list in back of catalog.

THE MIDGET CIRCULAR CALCULATOR



No. 3082

This compact little instrument is $2\frac{1}{2}$ inches in diameter and only $\frac{3}{4}$ inch in thickness, contained in imitation leather case and will fit the vest pocket. The divisions are clear and accurate and finely cut on two white dials. The covers are made of non-breakable glass, provided with indicator lines and two transparent buttons for turning to desired position.

To operate take hold of instrument by the two center knobs with the thumb and forefinger of the right hand and turn the case with the left hand. Turn glass dial with indicator by means of the buttons provided.

Instrument is fitted with square, cubic, logarithmic, sine and tangent scales and by means of the fore and back non-breakable glass slides it is possible to solve immediately the following calculations:

- | | |
|---------------------------------------|---------------------------|
| 1. Watt reduced to H. P. | 7. To cubic. |
| 2. H. P. reduced to Watt. | 8. Cubic extrication. |
| 3. Circle surface by circle diameter. | 9. Logarithmic numerus. |
| 4. Circle diameter by circle surface. | 10. Logarithmic mantissa. |
| 5. To square. | 11. Sine. |
| 6. Square extrication. | 12. Tangent. |

This instrument is operated in the same manner as the ordinary slide rule. It is not influenced by heat or cold and its compactness and durability and nominal cost have established its popularity.

No. 3082. Midget Circular Calculator in imitation leather case, with instructions. Each

See price list in back of catalog.

THE ROSS PRECISION COMPUTER



Multiplies—Divides.
Gives Reciprocals.
Solves Proportions.
Handles constant multipliers.
Handles constant divisors.
Handles constant ratios.
Reads 6-place logs and anti-logs.

Solves exponential problems.
Gives 8-place answers instantly.
Solves expressions like $a \times b \times c \times d$
 $e \times f \times g \times h$

With its trigonometric functions many engineers use it for traverses, obtaining 5-place accuracy, about 1 inch per mile.

Operation: $879.65 \times 7.2638 = ?$
Set 87965 under arm 3, clamp;
Set 72638 under arm 4.

Answer 6389.6 is under arm 3.
Slide checks answer—locates decimal.

The Ross Precision Computer is a new multiplier-and-divider of unusual precision. It solves problems like $879.65 \times 72.688 \div 74.769 = 854.58$, with an accuracy of 5 figures, i. e. to an ultimate accuracy of 1/1000 of 1%, or 1 in 100,000.

On the back of the Precision Computer are scales of natural sines, cosines, tangents and cotangents. They read minutes exact, interpolable to fractions of a minute. The Precision Computer is used for figuring earthwork, monthly and final estimates, unit cost and payroll, traverses for final design and reports. It is intended primarily for precise calculations where an accuracy of four to five significant figures is indispensable.

The Ross Precision Computer is particularly effective in heavy tabular work, with Constants. After setting Constants, each succeeding item requires only one turn of dial. Constants remain locked, and cannot shift accidentally, however numerous the items. This feature is valuable in figuring payroll, unit-cost, pro-rating, etc., etc. It permits three to five 5-place calculations per minute, 200 to 300 per hour,—as fast as an assistant can call off the data and write down the results.

MECHANICAL DETAILS

The Ross Precision Computer is graduated directly on heavy metal plate, easy to read and thoroughly durable; aluminum frame, trimmed in nickel; precisely machined, of fine workmanship and construction.

Nine inches in diameter; weighs net $1\frac{1}{2}$ lbs.; packed in fabrikoid case. Clamp is finely polished; trimmed in nickel; solid, durable.

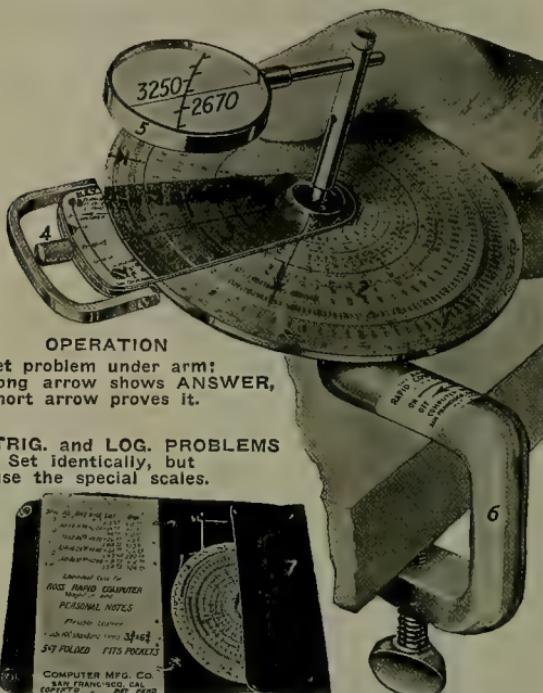
For convenience, accuracy and rigidity the Computer may be attached instantly and firmly to any desk-edge, by the Tilted Duplex Clamp. It permits fine settings to be made with great precision—with either the right, left, or both hands. Can be faced about in any convenient direction. A turn of Thumbnut 8 releases the Computer, ready to put in your desk or valise, among your papers.

Clamp is finely japanned, has polished nickel trimmings; solid, durable.

No. 3090. Ross Precision Computer, complete with tilted duplex clamp, case and full directions. Each.....

See price list in back of catalog.

THE ROSS RAPID COMPUTER



OPERATION

Set problem under arm:
Long arrow shows ANSWER,
Short arrow proves it.

TRIG. and LOG. PROBLEMS

Set identically, but
use the special scales.

The new Ross Rapid Computer solves all numeric, logarithmic and trigonometric problems. Polyphase duplex in principle, but with simpler, longer, and more complete scales. Solves in one setting problems like abc, a/bc, a sinx/cosy, ab tanx, log (a/bc), etc. 5-inch diam., 12½" contact scales, like upper scales of 25" rule.

Has 360° protractor and all 6 functions; actually practical for trigonometric work, traverses, stadia, etc. Figures quantities, capacity, unit cost, earthwork, etc. Shows answer and proof. Answer never runs off scale, no blank movements, each movement is effective. Unwarppable, unshrinkable; instantly convertible for desk or pocket.

Computer consists of scaled metal dials 1 and 2, set flush, and mounted on aluminum back. The graduations are sharply and deeply engraved into the basic metal; they will never wear out; but if accidentally marred or disfigured, dials may be renovated repeatedly, like new.

Aluminum arm 3 carries Thumbnut 4 for locking constants, and key to operation in plain sight of user.

No. 3092. Ross Rapid Computer, with full directions. Each.....

No. 3092A. Fine sewed leather pouch for No. 3092. Each.....

Magnifier, 1¾-inch diam., adjustable in focus, radius and direction. Makes interpolations more accurate, readings appear larger than ordinary typewriting. A touch of finger turns it aside; instantly detachable for separate use.

No. 3092C. Magnifier complete, with post and thumb-lock. As illustrated. Each.....

Desk Clamp, increases accuracy and convenience, relieves strain from hand and eye, like tripod for compass; permits writing with one hand while figuring with other. Instantly detachable. Made of aluminum, trimmed in nickel, finely machined, weight ½ pound.

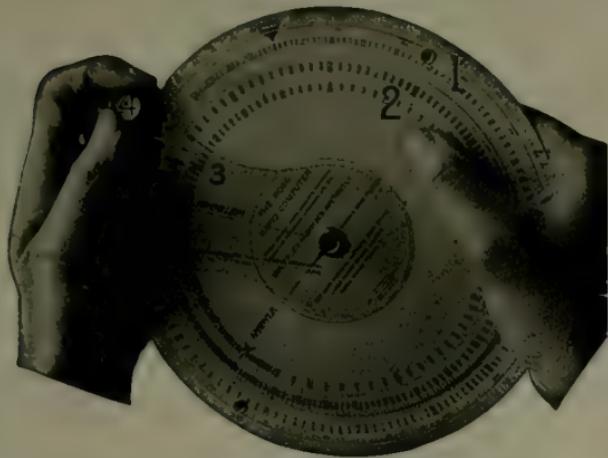
No. 3092D. Loose Leaf Case, with fillers and rings. Each.....

No. 3092X. Complete Set as illustrated and described. Each.....

For highest efficiency the Ross Rapid Computer was designed to be used as a Complete Set; this increases accuracy and comfort to the eye, is more convenient to use, permits one-hand operation, and is instantly convertible for desk or pocket, field or office. Purchasers are urged to avail themselves of these advantages.

See price list in back of catalog.

THE ROSS RAPID COMPUTER



8-INCH RAPID COMPUTER; graduated like No. 3092, but made of heavy celluloid, in 2 colors, with solid, handy metal arm that can be locked on any setting. The scales are open and easy to read. Durable, metal center; protective transparent cover. Packed in 8x9 loose-leaf fabrikoid book, with rings, fillers, and full directions.

No. 3094. 8-inch Celluloid Rapid Computer, complete. Each

ROSS COMMERCIAL COMPUTER

Commercial Rapid Computer—The Rapid Computer is also made for commercial use, without technical scales, for figuring payroll, simple and compound interest, discount, freight, profit and loss, prorating, unit costs, foreign exchange, mensuration, weight, in fact any and every calculation involving multiplication and division in any form. Very simple to operate; construction like No. 3094. Packed in 8x9 loose-leaf fabrikoid book, with rings, fillers and full directions.

No. 3095. 8-inch Commercial Computer, complete. Each

STUDENTS' RAPID COMPUTER

STUDENTS' RAPID COMPUTER; 5-inch diameter, scales like No. 3094, but made of heavy celluloid in 2 colors, with self-locking friction arm. Fits pocket without bulge, very light and handy. Packed in fabrikoid pouch, with full directions.

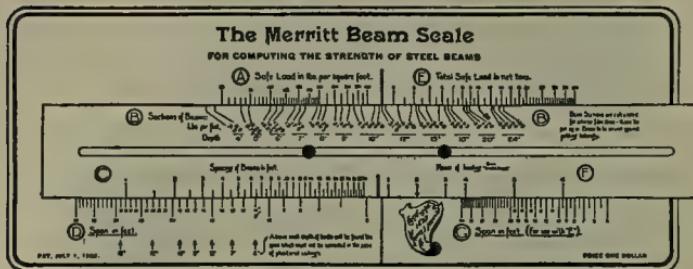
No. 3096. Students' Rapid Computer, complete. Each

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

THE MERRITT BEAM SCALE

For computing the strength of steel beams.



No. 3097

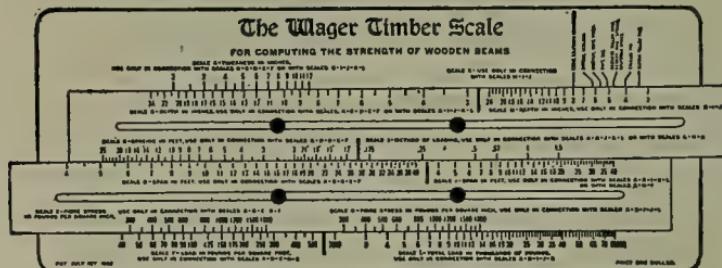
Absolutely accurate. Adapted to all conditions. Load, spacing, span, etc., found instantly. Mistakes absolutely eliminated.

The Merritt Beam Scale for computing the strength of steel beams is based on the principle of the Engineer's Slide Rule and was designed to simplify computations of this kind, and to eliminate all chance of errors. Tables and formulas are absolutely unnecessary when the Merritt Beam Scale is used, and the speed with which answers to widely varying problems may be solved can hardly be appreciated by anyone who has not had the pleasure of using it.

No. 3097. Merritt Beam Scale, on heavy bristol board. Each.....

THE WAGER TIMBER SCALE

For computing the strength of wooden beams.



No. 3098

For computing the strength of wooden beams. Absolutely accurate. Adapted to all conditions. Load, spacing, span, etc., found instantly. Mistakes absolutely eliminated.

To illustrate the simplicity of the Scale the following is given:

How far apart shall 6 in. x 12 in. timbers of white oak be placed to safely support a load of 150 pounds per square foot, the span being 18 feet, and New York law governing the design?

Select the fibre stress for white oak allowed in New York City (given on back of scale: 1000 pounds). Place 12 in scale B below 6 in scale A. Place 1000 in scale E over 150 in scale F. Above 18 in scale D read 2 ft.-0 in. in scale C.

The Wager Timber Scale, for computing the strength of wooden beams, contains more information than could be given in 500 pages of tables. It is based on the principle of the Engineer's Slide Rule, and five minutes' inspection will convince anyone that it is simplicity itself.

No. 3098. Wager Timber Scale, on heavy bristol board. Each.....

See price list in back of catalog.

STADIA COMPUTORS

COX STADIA COMPUTER

The Cox Stadia Computer is a circular slide rule of about fifteen inches effective length. The fixed outer scale, or base, is graduated to the logarithms of numbers from 1 to 1000. The movable inner disc, concentric with it, is graduated on a portion of its circumference to the logarithms of one-half the sine of twice the angles from 3 min. to 45 deg., and inscribed "Difference in Elevation." Another portion of its circumference is graduated to the logarithms of the cosine squared of the angles from 0 to 45 deg., and inscribed "Hor. Distance."

Printed on heavy celluloid, size $5\frac{1}{8} \times 5\frac{1}{8}$ inches, suitable for carrying in coat pocket.

- No. 3104.** Cox Stadia Computer. Each.....

STADIA SLIDE RULES



- No. 3110.** Stadia Slide Rule, engine divided, 10 in., white facing, glass indicator, in morocco case.....

- No. 3111.** Stadia Slide Rule, like No. 3110, but 20 in., in morocco case.

This is a very simple form of Stadia Slide Rule. When the stadia rod reading and elevation of the telescope are known the horizontal distance and vertical height can in every case be obtained at once by one setting (always to the left) of the slide. The rule can also be used for ordinary computations as the under side of the slide has a scale corresponding to the lower scale of the rule and resembling the A and B scale of the ordinary Mannheim rule. Directions are printed on the rule.

GRUNSKY STADIA REDUCTION DIAGRAM

- No. 3112.** Grunsky Stadia Reduction Diagram, paper, horizontal distances to 1000, differences of elevation 100, vertical angles to 30°

See price list in back of catalog.

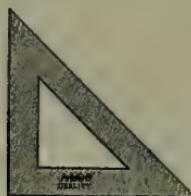
ALCO QUALITY DRAWING TOOLS

Every article in transparent celluloid and wood is made of the very best and finest material and guaranteed to be true and reliable.

HARDWOOD TRIANGLES



No. 3155



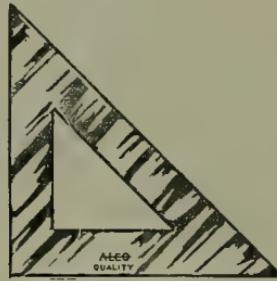
No. 3156

No. 3155.	Hardwood Triangles, framed, 30x60 degrees.			
Size, inches		8	10	12
Each				
No. 3156.	Hardwood Triangles, framed, 45 degrees.			
Size, inches		6	8	10
Each				

STEEL TRIANGLES



No. 3175



No. 3176

No. 3175.	Steel Triangles, nickel plated, open center, 30x60 degrees.			
Size, inches		8	10½	15
Each				
No. 3176.	Steel Triangles, nickel plated, open center, 45 degrees.			
Size, inches		8	10	12
Each				

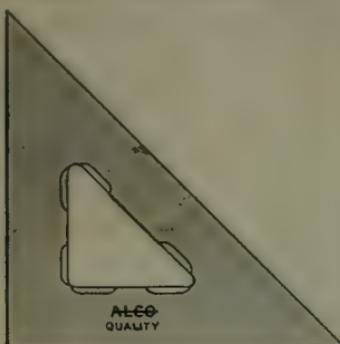
See price list in back of catalog.

TRANSPARENT AMBER TRIANGLES

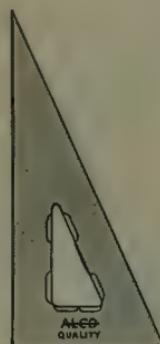
Best Quality. With finger lifts.



No. 3180



No. 3181



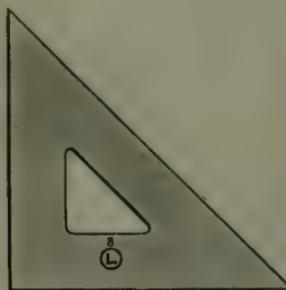
No. 3182

- No. 3180.** Transparent Amber Triangles, with finger lifts, 30x60 degrees.
Size, inches— 4 6 7 8 9 10 12 14 16 18
Each
- No. 3181.** Transparent Amber Triangles, with finger lifts, 45 degrees.
Size, inches— 4 5 6 7 8 9 10 12 14 16 18
Each
- No. 3182.** Transparent Amber Triangles, with finger lifts, 22½x67½ degrees.
Size, inches— 4 6 8 10
Each

Second Quality. Without finger lifts.



No. 3185



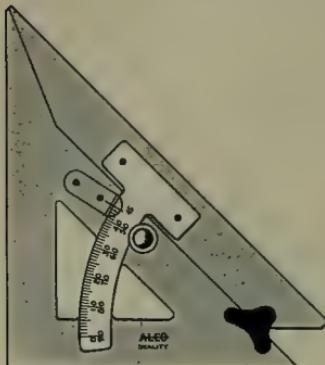
No. 3186

- No. 3185.** Transparent Amber Triangles, 30x60 degrees.
Size, inches— 8 9 10
Each
- No. 3186.** Transparent Amber Triangles, 45 degrees.
Sizes, inches— 6 7 8
Each

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

ADJUSTABLE TRIANGLES



Adjustable Angle No. 3192 is strongly made of extra heavy transparent amber celluloid. By means of a white celluloid arc divided to single degrees, any angle may be obtained and set with a metal clamp screw.

No. 3192

No. 3192.	Adjustable Angle, transparent amber, with graduated arc.	7	10
Size, inches—			
Each			

A NEW COMBINATION TRIANGLE



THE LINE-O-GRAPH does the work of triangles, protractor, irregular curve, scale, section liner, compass, and lettering angle. Illustrations show its manifold utility.

Made of heavy transparent amber celluloid. Each Line-O-Graph furnished in cardboard envelope and directions.

No. 3193. Transparent Amber Line-O-Graph.

Size, inches—	8	11
Each		

See price list in back of catalog.

THE AMES LETTERING INSTRUMENT

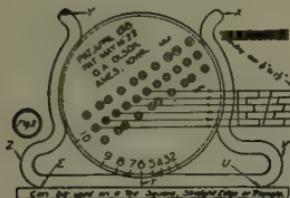


Fig. 1

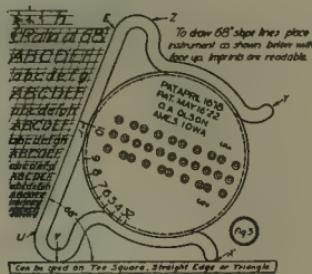


Fig. 3

The Ames Lettering Instrument is the only instrument of its kind that has holes spaced for three different systems of guide lines.

The AMES LETTERING INSTRUMENT is used for reducing the time consumed in placing guide lines on drawings when lettering titles and notes. This device consists of a nickel-plated, tempered steel frame, which retains a transparent celluloid disc that may be swiveled in the frame. The disc has three parallel rows of tapered holes, which furnish a means for quickly drawing guide lines without the necessity of first locating them by means of a scale. The fraction $3/5$ at the top of the disc indicates that the holes in the column are so spaced that the ratio between the guide lines will be $2/5$ and $3/5$ of the total height of a capital letter of that system. This is true for any position of the disc. This ratio is usually used by civil engineers. The fraction $2/3$ indicates that the ratio will be $1/3$ and $2/3$ of the total height of the letter. This is the ratio used in the Reinhardt system. The holes in the middle column are equally spaced for block lettering or cross hatching. In laying out the *guide lines*, the instrument is placed with the base in contact with a T-square or straightedge (see Figure 1) and then pulled alternately to the right and to the left by means of a pencil placed in the holes of the disc. *The vertical height between the guide lines may be regulated by swiveling the disc in the frame.* Slanting lines for letters may be quickly drawn by placing the instrument with the open and closed end in contact with the straightedge. (See Figure 3.)

No. 3194. Price of Ames Lettering Instrument.....

See price list in back of catalog.

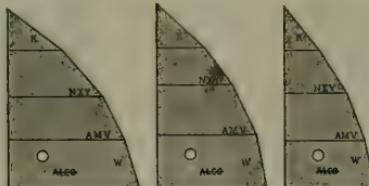
THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

LETTERING TEMPLETS



No. 3200 3½ inches high.

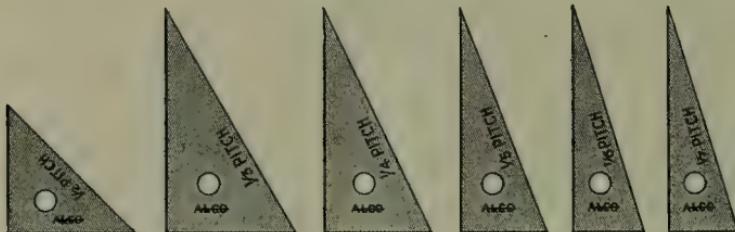
No. 3200. Transparent Amber Lettering Templets, 3 in set. Per set.....



No. 3201 3½ inches high.

No. 3201. Transparent Amber Lettering Templets, 3 in set. Per set.....

ROOF PITCHES

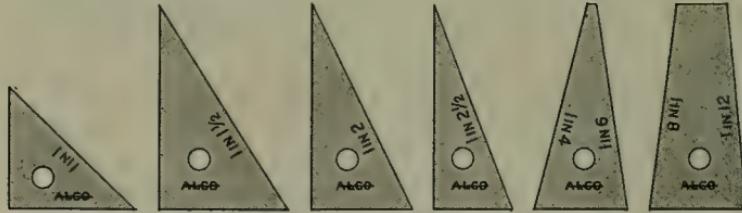


No. 3205

No. 3205. Transparent Amber Triangles for roof pitches, 6 in set. Per set....

No. 3205. Transparent Amber Triangles for roof pitches, if sold separate, each

TRIANGLES FOR EMBANKMENTS



No. 3208

No. 3208. Transparent Amber Triangles for embankments, 8 slopes on 6 templets. Per set

No. 3208. Transparent Amber Triangles for embankments, if sold separate, single slope, each

Double slope, each

See price list in back of catalog.

CELLULOID IN SHEETS

Suitable for cutting your own curves and angles

- No. 3220.** Transparent Amber Celluloid, extra heavy, 80/1000 in. thick.
Full sheet, 20x50 inches.....
Per running inch, 20 inches wide.....
Per square inch, less than 20 inches wide.....
- No. 3221.** Transparent Amber Celluloid, heavy, 60/1000 in. thick.
Full sheet, 20x50 inches.....
Per running inch, 20 inches wide.....
Per square inch, less than 20 inches wide.....
- No. 3222.** Transparent Amber Celluloid, medium, 40/1000 in. thick.
Full sheet, 20x50 inches.....
Per running inch, 20 inches wide.....
Per square inch, less than 20 inches wide.....
- No. 3223.** Transparent Celluloid, extra thin and flexible, 10/1000 in. thick.
Full sheet, 20x50 inches.....
Per running inch, 20 inches wide.....
Per square inch, less than 20 inches wide.....
- No. 3224.** Opaque White Photo Celluloid, polished one side only. Thin
and flexible. 10/1000 in. thick.
Full sheet, 20x50 inches.....
Per running inch, 20 inches wide.....
Per square inch, less than 20 inches wide.....

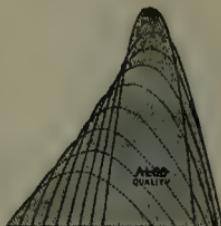
HYPERBOLAS, ELLIPSES AND PARABOLAS



No. 3230



No. 3232



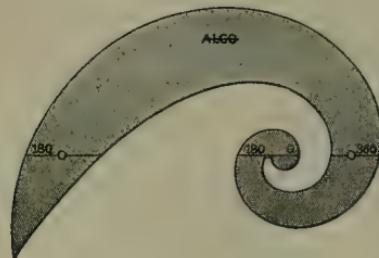
No. 3234

Transparent
Amber

- No. 3230.** Hyperbolas, 8 to set, 2 to $5\frac{1}{2}$ inch.....
No. 3232. Ellipses, 10 to set, $1\frac{1}{2}$ to 6 inches.....
No. 3233. Parabolas, 8 to set, $1\frac{1}{4}$ to $5\frac{1}{2}$ inches.....
No. 3234. Parabolas, 8 to set, $3\frac{3}{4}$ to $14\frac{3}{4}$ inches.....

See price list in back of catalog.

IRREGULAR CURVES
SPECIAL CURVES

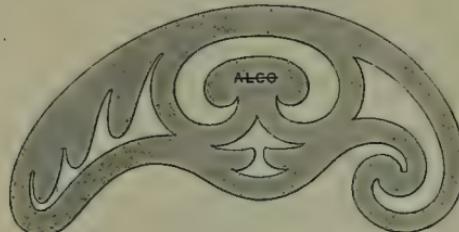


No. 3240



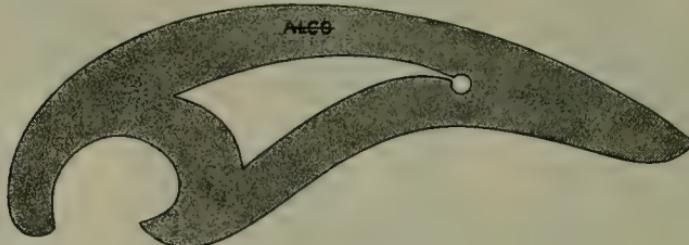
No. 3242

- No. 3240.** Logarithmic Spiral Curve, transparent amber. Each.....
No. 3242. Combination Curve, transparent amber. Each.....



No. 3244

- No. 3244.** Combination Curve, transparent amber. Each.....



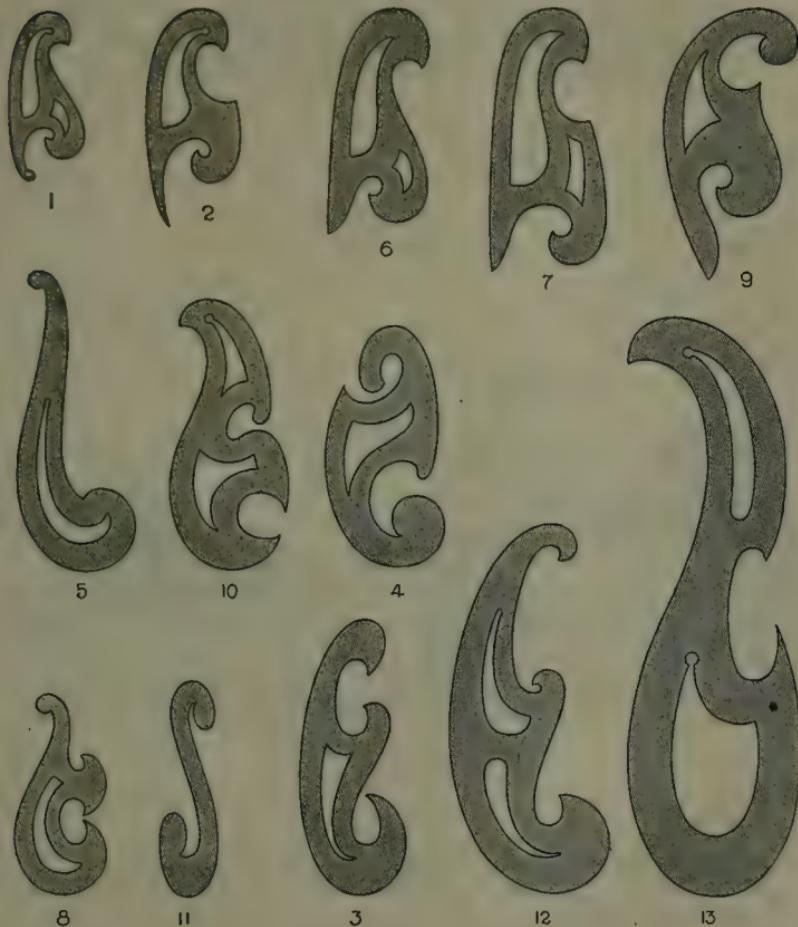
No. 3246

- No. 3246.** Aviation Curve, transparent amber. Each.....

See price list in back of catalog.

IRREGULAR OR FRENCH CURVES

Made of Transparent Celluloid or Wood



No. 3250. Hardwood Curves—
Pattern No... 1 2 3 4

No. 3251. Celluloid Curves—
Pattern No... 1 2 3 4 5 6 7 8 9 10 11 12 13

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

SPLINES

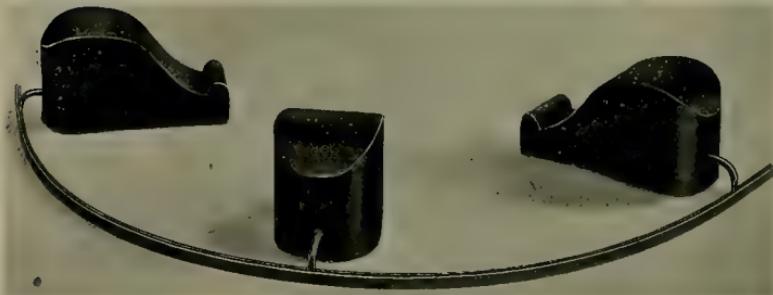
Made of Transparent Amber Celluloid or Wood



No. 3255

No. 3255.	Pearwood Splines, grooved.					
Length, inches—		36	42	48	60	
Each						
No. 3256.	Transparent Amber Celluloid Splines, grooved.					
Length, inches—		24	30	36	42	48
Each						60

WEIGHTS FOR SPLINES



No. 3260

No. 3260. Improved weights for Splines, with hook, 4 lbs. Each.....

SET OF SPLINES AND SPLINE WEIGHTS

No. 3265. Set of Splines and Spline Weights, in strong wooden box containing: 1 each Pearwood Spline 18, 24, 30, 36, 42 and 48 inches; 1 each Transparent Amber Celluloid Spline 18, 24, 30, 36 and 42 inches; 4 Spline Weights No. 3260.
Per set

See price list in back of catalog.

ADJUSTABLE CURVE RULERS



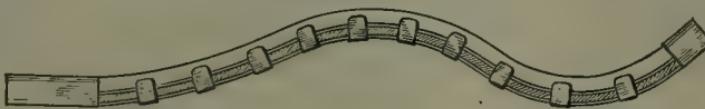
RUBBER
STEEL
LEAD
STEEL

Nos. 3270-72

No. 3270. Adjustable Curve Ruler, double edge, 7 in. long. Each..

No. 3271. Adjustable Curve Ruler, double edge, 15 in. long. Each..

No. 3272. Adjustable Curve Ruler, double edge, 31 in. long. Each..



Nos. 3275-76

No. 3275. Adjustable Curve Ruler, white rubber ruling edge, 12 in. long. Each

No. 3276. Adjustable Curve Ruler, white rubber ruling edge, 24 in. long. Each



No. 3278

No. 3278. Adjustable Curve Ruler, black rubber ruling edge, 14½ in. long. Each

This is a similar tool to Nos. 3275-76, but of better quality.



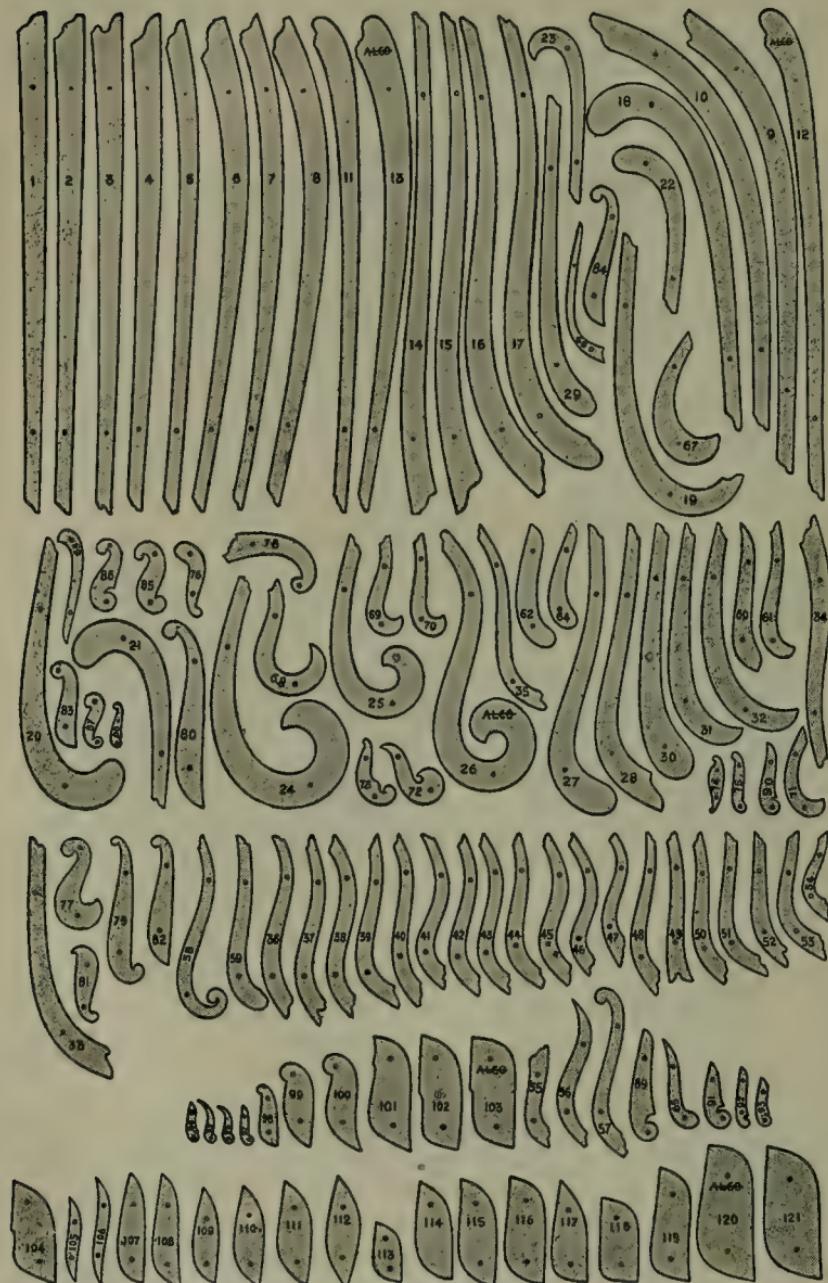
No. 3279

No. 3279. Adjustable Curve Ruler, steel ruling edge, 30 in. long. Each

The above rules can be instantly adjusted and retained to any form or curve. The working edge on rules Nos. 3270-78 is made of rubber and rounded, so that by slightly inclining the pencil or pen several parallel curves may be drawn without moving the ruler. Ruler No. 3279 has a square steel ruling edge.

See price list in back of catalog.

COPENHAGEN SHIP CURVES



Illustrations about one-ninth size.

No. 3290. Transparent Amber Copenhagen Ship Curves.....
For prices see opposite page.

See price list in back of catalog.

COPENHAGEN SHIP CURVES

No. 3290

Made of Transparent Amber

Pattern No.	Pattern No.	Pattern No.	Pattern No.
1	32*	62	92
2*	33*	63	93
3	34	64*	94
4*	35*	65	95
5	36*	66	96
6*	37	67	97
7	38	68*	98
8*	39*	69	99*
9	40	70	100*
10*	41	71	101*
11	42	72*	102
12	43	73	103
13*	44*	74	104
14	45	75	105
15*	46	76	106
16	47	77*	107*
17*	48*	78	108
18*	49	79	109
19	50	80	110*
20*	51*	81	111
21	52*	82	112
22	53*	83*	113
23*	54	84*	114*
24	55	85*	115
25*	56	86	116
26	57*	87	117
27	58	88	118*
28	59*	89*	119*
29*	60*	90	120
30*	61	91*	121*
31			

When ordering please state both catalogue and pattern number.

No. 3290A. Set of 45 transparent amber Ship Curves, containing one each curve of patterns marked * above. In hardwood case. Per set**No. 3290B.** Set of 121 transparent amber Ship Curves, containing one each curve No. 1 to 121. In hardwood case. Per set.....

SPECIAL CURVES MADE TO ORDER

We are prepared to manufacture to order special curves of any description. Work of this character is solicited by us and we will gladly furnish prices on special orders.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

CURVES FOR MECHANICAL ENGINEERS

Made of Transparent Amber Celluloid

In Sets



No. 3295

No. 3295. Set of 10 Transparent Amber Curves, for Mechanical Engineers, containing one each curve of patterns numbers 25, 30, 64, 72, 74, 79, 84, 89, 91 and 98, as listed under No. 3290 on page 399.
In wooden box. Per set.....

RAILROAD CURVES

Made of Transparent Amber Celluloid, Pearwood, Metal, and Cardboard.
With and without tangent.

These curves are of the best workmanship and material. They are true and circular, and are the same on both edges, so that either edge may be used.



No. 3307

For description and price list see opposite page.

See price list in back of catalog.

TRANSPARENT AMBER RAILROAD CURVES

With Tangent



Sets are put up in polished mahogany boxes with partitions, which are plainly marked with the value of the curve contained. Thus the required curve is easily picked out, and the chances of bending or warping the curves are entirely eliminated.

No. 3300. Transparent Amber Railroad Curves, with tangent, set of 55 curves, viz.: 3, 3½, 4, 4½, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 30, 32, 34, 35, 36, 38, 40, 45, 50, 55, 60, 65, 70, 75, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200 inches radius, in wooden **box with partitions**. Per set..

No. 3305. Transparent Amber Railroad Curves, with tangent, marked in degrees and inches, to scale 100 feet=1 inch, set of 41 curves, viz.:

0°.30'= 114.59 in.	3°.30'= 16.37 in.	6°.15'= 9.17 in.	9°.00'= 6.37 in.
1°.00'= 57.30 in.	3°.45'= 15.28 in.	6°.30'= 8.82 in.	9°.15'= 6.20 in.
1°.15'= 45.84 in.	4°.00'= 14.33 in.	6°.45'= 8.49 in.	9°.30'= 6.04 in.
1°.30'= 38.20 in.	4°.15'= 13.48 in.	7°.00'= 8.19 in.	9°.45'= 5.88 in.
1°.45'= 32.74 in.	4°.30'= 12.73 in.	7°.15'= 7.91 in.	10°.00'= 5.74 in.
2°.00'= 28.65 in.	4°.45'= 12.07 in.	7°.30'= 7.64 in.	10°.30'= 5.48 in.
2°.15'= 25.47 in.	5°.00'= 11.46 in.	7°.45'= 7.40 in.	11°.00'= 5.22 in.
2°.30'= 22.92 in.	5°.15'= 10.92 in.	8°.00'= 7.17 in.	11°.30'= 4.99 in.
2°.45'= 20.84 in.	5°.30'= 10.42 in.	8°.15'= 6.95 in.	
3°.00'= 19.10 in.	5°.45'= 9.97 in.	8°.30'= 6.75 in.	
3°.15'= 17.63 in.	6°.00'= 9.55 in.	8°.45'= 6.55 in.	

In wooden box with partitions. Per set.....

No. 3307. Transparent Amber Railroad Curves, with tangent, marked in degrees and inches to scale 100 feet=1 inch, set of 55 curves, viz.:

0°.15'= 229.18 in.	3°.45'= 15.28 in.	7°.15'= 7.91 in.	11°.30'= 4.99 in.
0°.30'= 114.59 in.	4°.00'= 14.33 in.	7°.30'= 7.64 in.	12°.00'= 4.78 in.
0°.45'= 76.39 in.	4°.15'= 13.48 in.	7°.45'= 7.40 in.	12°.30'= 4.59 in.
1°.00'= 57.30 in.	4°.30'= 12.73 in.	8°.00'= 7.17 in.	13°.00'= 4.42 in.
1°.15'= 45.84 in.	4°.45'= 12.07 in.	8°.15'= 6.95 in.	13°.30'= 4.25 in.
1°.30'= 38.20 in.	5°.00'= 11.46 in.	8°.30'= 6.75 in.	14°.00'= 4.10 in.
1°.45'= 32.74 in.	5°.15'= 10.92 in.	8°.45'= 6.55 in.	14°.30'= 3.96 in.
2°.00'= 28.65 in.	5°.30'= 10.42 in.	9°.00'= 6.37 in.	15°.00'= 3.83 in.
2°.15'= 25.47 in.	5°.45'= 9.97 in.	9°.15'= 6.20 in.	16°.00'= 3.59 in.
2°.30'= 22.92 in.	6°.00'= 9.55 in.	9°.30'= 6.04 in.	17°.00'= 3.38 in.
2°.45'= 20.84 in.	6°.15'= 9.17 in.	9°.45'= 5.88 in.	18°.00'= 3.20 in.
3°.00'= 19.10 in.	6°.30'= 8.82 in.	10°.00'= 5.74 in.	19°.00'= 3.03 in.
3°.15'= 17.63 in.	6°.45'= 8.49 in.	10°.30'= 5.48 in.	20°.00'= 2.88 in.
3°.30'= 16.37 in.	7°.00'= 8.19 in.	11°.00'= 5.22 in.	

In wooden box, with partitions. Per set.....

No. 3307A. Separate Transparent Amber Railroad Curves, with tangent. Each

Railroad Curves of any desired scale cut to order.

See price list in back of catalog.

TRANSPARENT AMBER RAILROAD CURVES

Without tangent



- No. 3310.** Transparent Amber Railroad Curves, without tangent, set of 10 curves, viz.: 12, 24, 36, 48, 60, 72, 84, 96, 108, 120 inches radius, in wooden box. Per set
- No. 3311.** Transparent Amber Railroad Curves, without tangent, set of 17 curves, viz.: 12, 15, 18, 21, 24, 27, 30, 33, 36, 39, 42, 45, 48, 51, 54, 57, 60 inches radius, in wooden box. Per set
- No. 3312.** Transparent Amber Railroad Curves, without tangent, set of 24 curves, viz.: 2, 2½, 3, 3½, 4, 4½, 5, 5½, 6, 6½, 7, 7½, 8, 8½, 9, 9½, 10, 12, 14, 16, 18, 20, 22, 24 inches radius, in wooden box. Set
- No. 3313.** Transparent Amber Railroad Curves, without tangent, set of 43 curves, viz.: 3½, 4, 4½, 5, 5½, 6, 6½, 7, 7½, 8, 8½, 9, 9½, 10, 12, 14, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 42, 48, 54, 60, 66, 72, 78, 84, 90, 100, 110, 120, 130, 140, 160, 180, 200 inches radius, in wooden box. Per set
- No. 3313A.** Separate Transparent Amber Railroad Curves, without tangent. Each

PEARWOOD RAILROAD CURVES



- No. 3320.** Pearwood Railroad Curves, without tangent, 10 in set, viz.: 12, 24, 36, 48, 60, 72, 84, 96, 108, 120 inches radius, in wooden box. Set
- No. 3321.** Pearwood Railroad Curves, without tangent, 17 in set, viz.: 12, 15, 18, 21, 24, 27, 30, 33, 36, 39, 42, 45, 48, 51, 54, 57, 60 inches radius, in wooden box. Per set
- No. 3323.** Pearwood Railroad Curves, without tangent, 43 in set, viz.: 3½, 4, 4½, 5, 5½, 6, 6½, 7, 7½, 8, 8½, 9, 9½, 10, 12, 14, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 42, 48, 54, 60, 66, 72, 78, 84, 90, 100, 110, 120, 130, 140, 160, 180, 200 inches radius, in wooden box. Per set
- No. 3323A.** Separate Pearwood Railroad Curves, without tangent. Ea.

See price list in back of catalog.

METAL RAILROAD CURVES

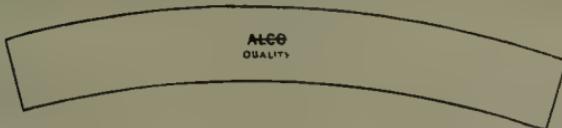
Without tangent.



- No. 3325. Metal Railroad Curves, 10 in set, 12 to 120 inches radius, viz.: 12, 24, 36, 48, 60, 72, 84, 96, 108, 120 inches, in wooden box.
- No. 3326. Metal Railroad Curves, 17 in set, 12 to 60 inches radius, viz.: 12, 15, 18, 21, 24, 27, 30, 33, 36, 39, 42, 45, 48, 51, 54, 57, 60 inches, in wooden box.
- No. 3326A. Separate Metal Railroad Curves without tangent. Each..

CARDBOARD RAILROAD CURVES

Without tangent.



- No. 3330. Cardboard Railroad Curves, 30 in set, viz.: 1½, 2, 2½, 3, 3½, 4, 4½, 5, 5½, 6, 7, 8, 9, 10, 11, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 35, 40, 45, 50, 60 inches radius, in wooden box. Per set
- No. 3331. Cardboard Railroad Curves, 50 in set, viz.: 1½, 2, 2½, 3, 3½, 4, 4½, 5, 5½, 6, 6½, 7, 7½, 8, 8½, 9, 9½, 10, 10½, 11, 11½, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 110, 120 inches radius, in wooden box. Per set

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

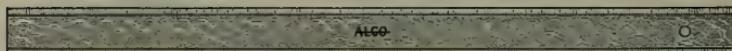
STRAIGHTEDGES



No. 3350

No. 3350. CHERRY STRAIGHTEDGES, one edge beveled.

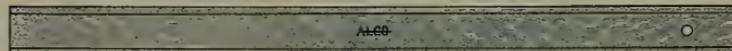
Sizes, inches	18	24	30	36	42
Each					



No. 3352

No. 3352. HARDWOOD-LINED STRAIGHTEDGES, square edges.

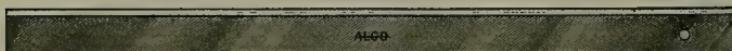
Sizes, inches	24	30	36	42	48	54	60	72	84	96	120
Each											



No. 3356

No. 3356. MAPLE TRANSPARENT AMBER-LINED STRAIGHTEDGES.

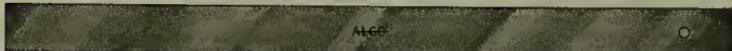
Sizes, inches	18	24	30	36	42	48	54	60	72
Each									



No. 3358

No. 3358. STEEL STRAIGHTEDGES, nickel plated, **one edge beveled.**

Sizes, inches	15	18	24	30	36	42	48	60	72
Width, inches ...	1 $\frac{3}{8}$	1 $\frac{3}{8}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{3}{4}$	1 $\frac{3}{4}$	2	2	2 $\frac{1}{2}$
Each									



No. 3360

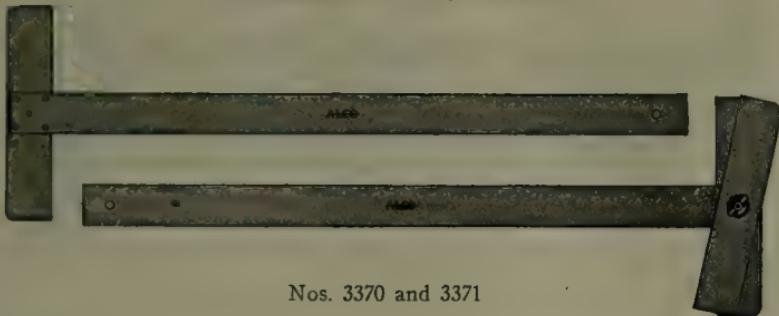
No. 3360. STEEL STRAIGHTEDGES, nickel plated, **square edges.**

Sizes, inches	15	18	24	30	36	42	48	60	72
Width, inches ...	1 $\frac{3}{8}$	1 $\frac{3}{8}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{3}{4}$	1 $\frac{3}{4}$	2	2	2 $\frac{1}{2}$
Each									

See Parallel Straightedge Attachment, page 408.

See price list in back of catalog.

WOODEN T-SQUARES



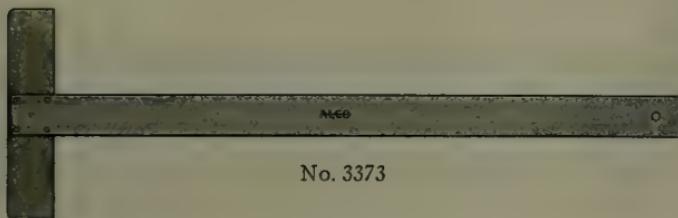
Nos. 3370 and 3371

No. 3370. Hardwood, plain blade, fixed head.

Size, inches—	15	18	21	24	30
Each					

No. 3371. Hardwood, plain blade, shifting head.

Size, inches—	24	30			
Each					



No. 3373

No. 3373. Pearwood, extra quality, fixed head.

Size, inches—	24	30	36	42	
Each					



No. 3375

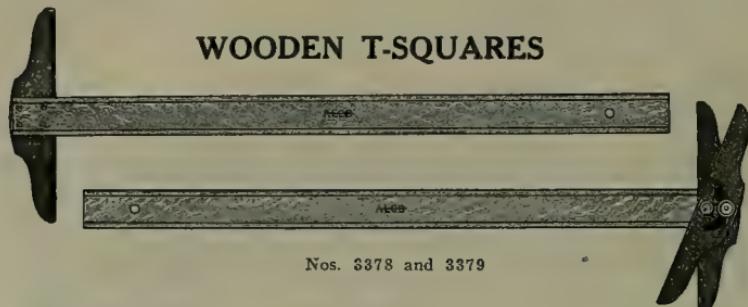
No. 3375. Maple Blade, walnut fixed head.

Size, inches—	15	18	24	30	36	42
Each						

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

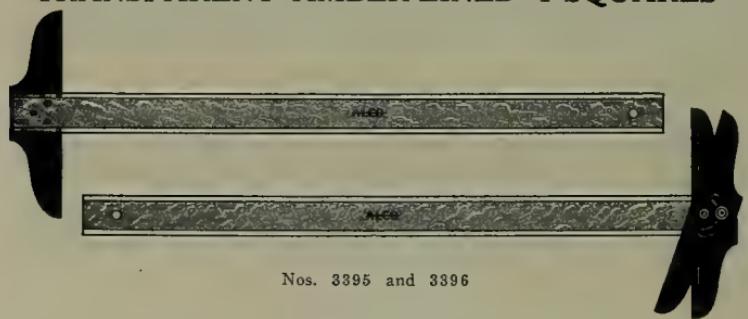
WOODEN T-SQUARES



Nos. 3378 and 3379

- No. 3378. Hardwood-lined blade, walnut fixed head.
Size, inches— 24 30 36 42 48 60 72
Each.....
- No. 3379. Hardwood-lined blade, walnut shifting head, with two fine brass milled swivels.
Size, inches— 24 30 36 42 48 60 72
Each.....

TRANSPARENT AMBER-LINED T-SQUARES



Nos. 3395 and 3396

Best Quality

- No. 3395. Transparent amber-lined maple blade, ebony fixed head.
Size, inches— 15 18 24 30 36 42 48 54 60 72
Each.....
- No. 3396. Transparent amber-lined maple blade, ebony shifting head, with two fine brass milled swivels.
Size, inches— 15 18 24 30 36 42 48 54 60 72
Each.....
- Note: The 15 and 18-inch T-Squares have only one brass swivel.

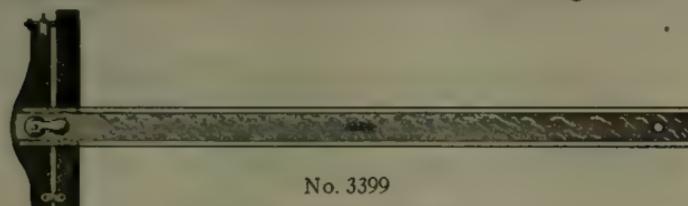
Second Quality

- No. 3397. Transparent amber-lined maple blade, fixed head.
Size, inches— 18 24 30 36
Each.....
- No. 3398. Transparent amber-lined maple blade, shifting head.
Size, inches— 18 24 30 36
Each.....

These T-Squares are of a cheaper construction than our Nos. 3395-96 and are made to meet the demands of the student, etc.

See price list in back of catalog.

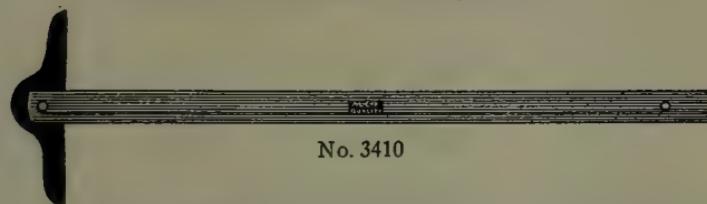
TRANSPARENT AMBER-LINED T-SQUARES



No. 3399

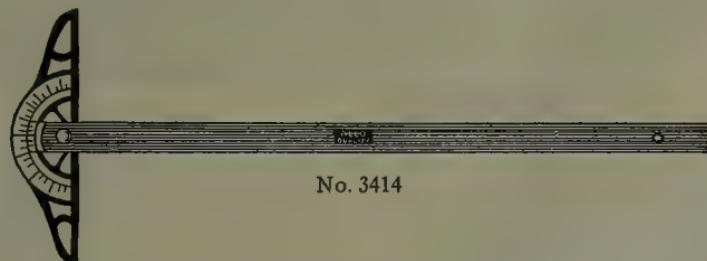
- No. 3399.** Transparent amber-lined maple blade, movable head with patent nickel-plated clamping swivel, and micrometer adjustment. Best quality.
Size, inches— 24 30 36 42 48
Each

STEEL BLADE T-SQUARES



No. 3410

- No. 3410.** Steel blade nickel-plated, fixed japanned iron head.
Size, inches— 20 24 30 36 48
Each



No. 3414

- No. 3414.** Protractor T-Square, steel blade, nickel-plated, shifting head, with protractor divided to half degrees, vernier on end of blade reading to minutes.
Size inches— 24 30 36 42
Each

ENGRAVERS' T-SQUARES



No. 3416

- No. 3416.** Steel blade, fixed brass head.
Size, inches— 6 8 12
Each

- No. 3417.** Steel blade, shifting brass head, with swivel.
Size, inches— 6 ■ 12
Each



No. 3417

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

ADJUSTABLE METAL DRAWING BOARD EDGE



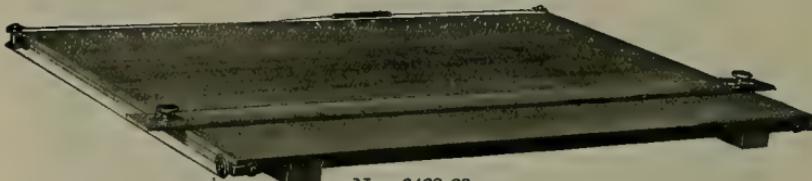
No. 3420

No. 3420. Adjustable Metal Drawing Board Edge. This consists of a metal T-rail, or straightedge with attachments to secure it to end, or end and side of drafting board or table. These are ground perfectly straight and are nickel plated. The T-square used against this insures more accurate results than can be obtained by working against wooden board or table.

Size, inches	24	30	36	40	48	60
Each						

A cam device at the end permits fine adjustments in forming a perfect right angle when two of the metal T-rails are used together.

PARALLEL STRAIGHTEDGE



Nos. 3428-29

The Parallel Straightedge consists of a set of two double pulleys attached to the back corners of the drawing board, and two single pulleys attached to the front corners. A steel piano wire is placed around these pulleys, making a double lap along each end and back of the board but no wire across the front. By crossing the wire at the back, the upper laps at both ends must move forward and back simultaneously.

The ends of the wire are joined together at the back through a steel spring. Both ends of the straightedge are attached to the upper wires at the ends of the board by binding posts, thus making it impossible to move one end of the straightedge without moving the other a corresponding amount in the same direction.

All pulleys, brackets and binding posts are made of brass, accurately machined, highly polished, and lacquer finished.

PRICES OF STRAIGHTEDGES ONLY

No. 3428.	Maple, Transparent Amber Lined Parallel Straightedges.					
	Length of board, inches..	36	42	48	55	60
	Price				72	84

PRICE OF PARALLEL ATTACHMENT ONLY

No. 3429.	Parallel Attachment, consisting of all pulleys, brackets and piano wire. Per set
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See price list in back of catalog.

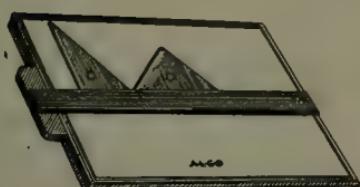
PERSPECTIVE LINEADS



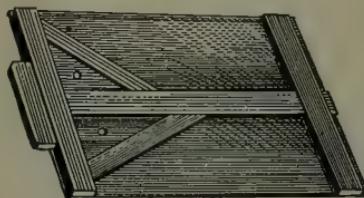
No. 3430
Nickel-plated mountings.

No. 3430.	Maple Blades, 24 inches, arms 10 inches long.....	Each
No. 3431.	Maple Blades, 30 inches, arms 11 inches long.....	
No. 3432.	Maple Blades, 36 inches, arms 12 inches long.....	

Perspective Lineads are used when the vanishing point of a perspective drawing is beyond the drawing board. One of the blades may be shifted to either end of the cross head, for use from the right and left-hand side. Instructions with each Perspective Linead.

SUITCASE DRAWING KITS OR SKETCH
BOARDS

Top



Bottom

The Suitcase Drawing Kit or Sketch Board consists of a drawing board, a T-square, and two wooden triangles, one 45 degrees and one 30x60 degrees. The board is lightly constructed and may easily be carried in a suitcase. It is reinforced on the under side with cleats, one at each end, to prevent it from warping. When not in use the triangles and T-square are held firmly in place, by means of a small metal spring, under one of the end cleats. An excellent drawing board for outside sketching and for students.

No. 3435.	Suitcase Drawing Kit 10x12.....	Each
No. 3436.	Suitcase Drawing Kit 13x19.....	
No. 3437.	Suitcase Drawing Kit 17x22.....	

See price list in back of catalog.

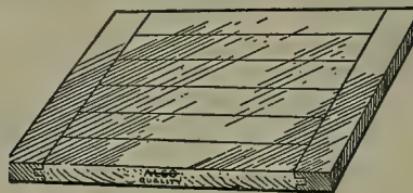
THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

DRAWING BOARDS

Our Drawing Boards are of the best workmanship and material. They are made of narrow strips of lumber, tongue and grooved, specially selected and thoroughly seasoned.

BASSWOOD DRAWING BOARDS

We recommend these boards for all schools and colleges. The wood is entirely without grain, the thumbtacks are easily removed, and the points will not leave pin holes.



No. 3440

With dovetailed end cleats, surfaced both sides.

No. 3440. Basswood Drawing Board.

	Each	Each
12x17	20x26	
16x21	23x31	
18x24	31x42	
19x25		

THREE-PLY BASSWOOD DRAWING BOARDS

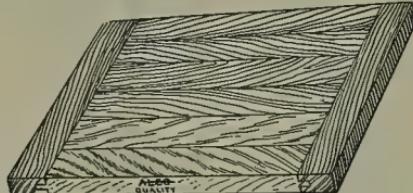
These Boards are light and strong, specially suitable for outdoor sketching.

No. 3442. Three-ply Basswood Drawing Boards, surfaced both sides.

	Each	Each
15x20	20x30	
20x26	30x40	

PINEWOOD DRAWING BOARDS

Made of narrow strips of thoroughly seasoned pinewood, especially selected. Dovetailed and end cleats.



No. 3445

No. 3445. Pinewood Drawing Board, surfaced both sides.

	Each	Each
12x17	23x31	
16x21	31x42	
20x26		

See price list in back of catalog.

PINEWOOD DRAWING BOARDS

Extra Fine Quality.

With Hardwood Ledges.

The hardwood ledges are attached to the board by means of screws, which pass through oblong slots, with metal oblong washers, to allow for contraction and expansion.

Made in our own factory, of narrow strips of thoroughly seasoned Pine-wood, especially selected. Finished with a light coat of shellac.



No. 3450

No. 3450. Pinewood Drawing Board.

	Each	Each
31x42	48x84	
33x55	48x96	
36x48	48x108	
36x60	48x120	
36x72	54x96	
36x84	54x108	
42x60	54x120	
42x72	60x96	
42x84	60x108	
42x96	60x120	
48x72		

Note: All the larger boards have three hardwood ledges. We can make any other size board to order. Delivery about two weeks. The above prices include crating for shipment.

For Trestles and Horses for drawing boards see pages 413 to 418.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

DETAIL DRAWING BOARDS

These boards are of the highest quality. Made of narrow strips of thoroughly seasoned Pinewood, especially selected. The hardwood ledges are attached to the board by means of screws, which pass through oblong slots, with metal oblong washers, to allow for contraction and expansion. Ends inlaid with hardwood strips to assure a smooth working edge. The under side of these boards is grooved and the ends are cut to further allow for contraction or expansion. Finished with light coat of shellac.



No. 3452

No. 3452. Pinewood Detail Drawing Board.

	Each	Each
16x21	31x42	
20x26	33x55	
23x31	36x60	

Other sizes to order.

DRAWERS FOR DRAWING BOARDS



No. 3454A



No. 3454B

No. 3454A. Drawers for drawing boards, 20 x 24 x 4 inches inside, partitioned, with cleats to attach to board.....	Each
No. 3454B. Drawers for drawing boards, 20 x 24 x 4 inches inside with sliding tool tray, with cleats to attach to board.....	

See price list in back of catalog.

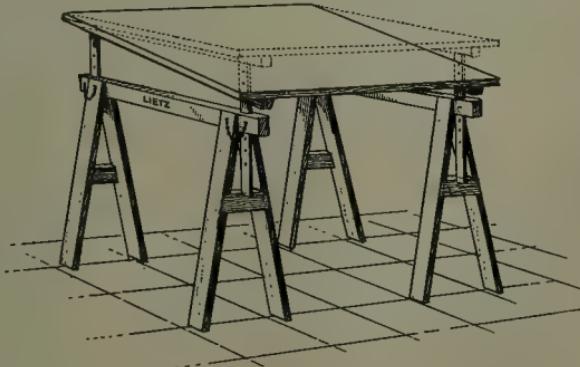
HORSES AND TRESTLES FOR DRAWING BOARDS



All horses are 37 inches high.

- | | |
|-----------|--|
| No. 3475. | Plain Wooden Horses, pinewood, straight top only, 30 inches wide. Per pair |
| No. 3476. | Plain Wooden Horses, pinewood, straight top only, 38 inches wide. Per pair |
| No. 3477. | Wooden Horses, fine quality, straight top only, 30 inches wide. Per pair |
| No. 3478. | Wooden Horses, fine quality, straight top only, 38 inches wide. Per pair |
| No. 3479. | Removable slanting top, 30 inches wide. Per pair..... |
| No. 3480. | Removable slanting top, 38 inches wide. Per pair..... |

ADJUSTABLE WOODEN HORSES



No. 3484

- | | |
|-----------|---|
| No. 3484. | Adjustable Wooden Horses, fine quality, with top 35 inches wide, adjustable for height from 37 to 47 inches on slope or level. Per pair |
|-----------|---|

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

**THE "FREMONT" COMBINATION DRAWING
TABLE**



No. 3486

The Fremont Combination Drawing Table meets every requirement of the draftsman and is especially popular because it may be put to general use when not needed for drawing. It is neatly finished and fits in with the other furniture of the home and apartment. The construction is light and strong and the table is collapsible and can be moved with ease and is also desirable for lecture work or outdoor sketching. The top is secured flat in a horizontal position, but may on a moment's notice be elevated to any slant for the convenience of the draftsman.

This table is sold without drawing board top as any drawing board No. 3440 or No. 3445 can be used. For poster work, oil painting, lecture or entertainment a special swivel bolt for attaching board in upright position is furnished.

No. 3486. Fremont Combination Drawing Table. Each.....

No. 3486A. Special Swivel Bolt for attaching board in upright position. Each

See price list in back of catalog.

THE "PIEDMONT" FOLDING DRAWING TABLE



No. 3488



There is a demand for a light, adjustable table and the Piedmont Table will answer every requirement in this line.

It is well braced and substantially made and can be folded and moved about without inconvenience.

All tables have hardwood base and pine drawing board top, finished natural color.

No. 3488. Piedmont Folding Drawing Table
with drawing board top, size 32x42 inches.
Height 38 inches

Shipping weight, 75 lbs.

The above table can be furnished in other sizes on special order. It is very suitable for educational institutions and quotations will be cheerfully furnished on quantities.

See price list in back of catalog.

THE "LAKEPORT" DRAWING TABLE



No. 3489

The Lakeport Drawing Table is strong, rigid, durable and well adapted for professional work or for use in the drafting room of educational institutions. The stand is made of hardwood and the pinewood top is made of narrow dove-tailed strips. Natural finish. The cross-bar fits into the standards which are slotted, and steel rods running full length are tightened after table is adjusted. This makes it very rigid and strong.

Table No. 3489A is adjustable from 30 to 40 inches and Nos. 3489B and D can be adjusted from 32 to 40 inches in height. Semi-circular iron braces allow a maximum tilting adjustment of the drawing board top.

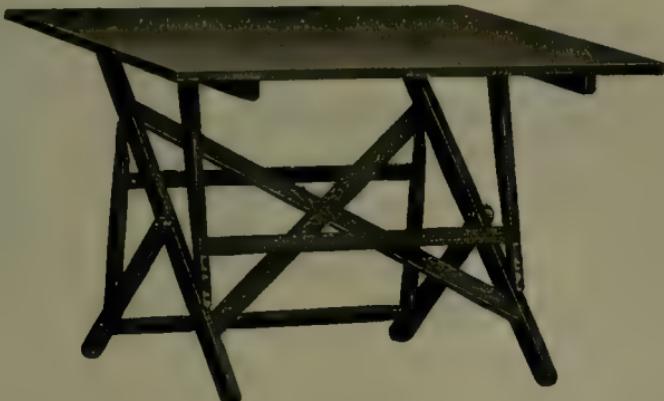
No. 3489A. Lakeport Drawing Table with drawing board top. 24x32 inches. (Shipping weight 45 lbs.)\$

No. 3489B. Lakeport Drawing Table with drawing board top. 32x42 inches. (Shipping weight 85 lbs.)\$

No. 3489D. Lakeport Drawing Table with drawing board top. 36x60 inches. (Shipping weight 125 lbs.)\$

See price list in back of catalog.

THE "OAKLAND" TRESTLE DRAWING TABLE



No. 3490

The Oakland Trestle Drawing Table is light in weight, folds very compactly and is easily moved from place to place. It is easily adjusted and rests firmly in any position. Adjustments range from 29 to 42 inches in height. Fitted with high-grade pinewood drawing board top.

No. 3490B. Oakland Trestle Drawing Table with drawing board top
32x42 inches. (Shipping weight 80 lbs.).....\$

No. 3490C. Oakland Trestle Drawing Table with drawing board top
37x48 in. (Shipping weight 100 lbs.)

No. 3490D. Oakland Trestle Drawing Table with drawing board top
37x60 inches. (Shipping weight 120 lbs.).....\$

Oakland Trestle Drawing Tables can be furnished in other sizes on special order. Quotations sent on request.

See price list in back of catalog.

TRESTLES FOR DRAWING BOARDS



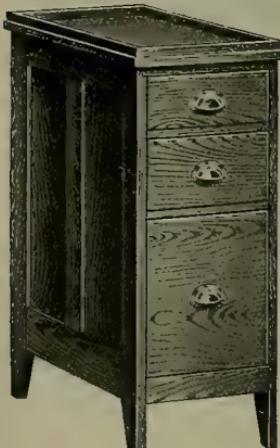
No. 3492

Adjustable Hardwood Trestles only for Large Drawing Boards
For Boards to fit see No. 3450.

No. 3492. Adjustable hardwood Trestle only, Birch.....

These trestles are designed to be used for different length tops. They can be adjusted to any height or desired slant, and the standards can be set to accommodate any size board from 42 to 100 inches or more in length. The extreme length of the cross rails is 72 inches, and the top rails are 36 inches wide.

DRAFTING ROOM CABINET



No. 3493

This cabinet fills a real demand for a handy and efficient accessory to the drafting table.

It will be found especially useful for the chief draftsman or foreman.

It has a rim around the top $\frac{5}{8}$ inch high to prevent ink bottles and other articles from falling off.

The two drawers at the top are for ink, tools, etc. One drawer is $3\frac{3}{4}$ inches deep, $9\frac{1}{8}$ inches wide, and $16\frac{1}{8}$ inches long inside, and one drawer same as above but 5 inches deep inside. The large drawer is $11\frac{3}{4}$ inches deep, for letters or catalogs.

The cabinet is equipped with sliding shoes and is made of oak, well finished.
depth 20 inches. Shipping weight 100 lbs.

Dimensions: Height 32 inches, width 12 inches,
No. 3493. Oak Drafting Room Cabinet.

Each

See price list in back of catalog.

DRAFTSMEN'S APRONS AND SMOCKS



No. 3495



No. 3494

No. 3494. Draftsmen's Apron, green felt. Each

No. 3495. Draftsmen's Smock. Each

Draftsmen's Smocks are a protection to the garment over which they loosely but neatly fit. Made of strong cotton material, tan or light blue in color, in one size only, accommodating both male and female. Buttoned in front, easily slipped on and off.

DUSTING BRUSHES

For removing crumbs of rubber, etc., from drawings.



No. 3500

No. 3500. Dusting Brush, invisible wire drawn, 8-in. brush with 6-in. handle. Each

No. 3501. Dusting Brush, similar to No. 3500, but all bristle, set in pitch; 8-in. brush with 6-in. handle. Each

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

THE "IDEAL" DRAWING STAND

The Ideal Drawing Stand is in a class by itself. Its neat design, beautiful finish and adjustable features have made it the favorite among artists, draftsmen, and it has been adopted as the standard of equipment in many of our colleges and high schools. The drawing board top can be instantly adjusted to any desired position and revolved on its center. It can be raised or lowered to a convenient height. The material tray can be adjusted to any position on either left or right hand side of the stand. To prevent scratching the floor large corks are inserted in the feet. Stand can be quickly knocked down and packed in small space for shipment.



No. 3506 with No. 3507A



No. 3507B

No. 3506. Ideal Drawing Stand with drawing board top 23x31 in....\$

No. 3507A. Oak Tray 14x10 in. and attachments for Ideal Drawing
Stand

No. 3507B. Extension Arm for Ideal Drawing Stand.....\$

The Ideal Drawing Stand can be furnished with drawing board tops of other sizes. No. 3440 Basswood boards are furnished. Price of other sizes is established by deducting price of board size 23x31 and adding price of other board.

See price list in back of catalog.

THE "IDEAL" ADJUSTABLE DRAWING BOARD BRACKET



No. 3508

The Ideal Adjustable Drawing Board Bracket is made of steel and iron nicely enameled. It can be instantly and firmly clamped to a table or other convenient place and will easily support a drawing board 23x31 inches, as it is very strong. Board can be tilted to any desired angle and revolved on its center.

No. 3508. Ideal Adjustable Drawing Board Bracket with screws to attach to Drawing Board. Each

THE "PEERLESS" DRAWING STAND



No. 3509 with 3507A

This handsome stand has the same adjustments as our Ideal Drawing Stand and is slightly heavier in construction. It has no equal as a handsome, serviceable stand; shipped knocked down.

Each

No. 3509. Peerless Drawing Stand with drawing board top 23x31 in.

No. 3507A. Oak Tray, 14x10 in., and attachments for Peerless Drawing Stand.

No. 3507B. Extension Arm for Peerless Drawing Stand.

The Peerless Drawing Stand can be furnished with Drawing Board Tops of other sizes. No. 3440 Basswood boards are furnished. Price of other sizes is established by deducting price of board size 23x31 and adding price of other board.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

THE NEW "AVALON" DRAWING TABLE

With foot lever adjustment



No. 3520 with Nos. 3521A and 3521B

The Avalon Drawing Table is very substantial and rigid. Height, adjustable from 32 to 48 inches. Base of best gray cast iron finished with several coats of black enamel.

The top has a positive vertical adjustment with racks and pinions operated from the front of the table by the foot lever at the right. The top is raised about $2\frac{1}{2}$ inches by each downward thrust of the foot lever, and locks automatically, while the lever springs back as soon as the foot is removed. There is a patented locking device which not only prevents the top sliding down, but also automatically clamps it without tightening hand screws or levers. The greater the strain the firmer the clamp holds. By turning the small hand wheel at the right the top is lowered gradually so there is no possibility of it going down with a bang. All working parts are enclosed in metal case.

The top swings from a horizontal to a vertical position, independent of the height, and is firmly clamped at any angle, at the back of the table, making it possible to change the inclination as well as the height easily and quickly. Steel springs counterbalance the height of the top when clamps are released.

Furnished with our best quality pinewood drawing boards No. 3450.

Each

No. 3520.	Avalon Drawing Table, with pinewood top 31x42	.....
	Avalon Drawing Table, with pinewood top 33x55	.....
	Avalon Drawing Table, with pinewood top 36x48	.....
	Avalon Drawing Table, with pinewood top 36x60	.....
	Avalon Drawing Table, with pinewood top 36x72	.....
	Avalon Drawing Table, with pinewood top 42x60	.....
	Avalon Drawing Table, with pinewood top 42x72	.....
	Avalon Drawing Table, with pinewood top 48x72

No. 3520A.	Avalon Drawing Stand only, without board....
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ACCESSORIES FOR AVALON DRAWING TABLE

No. 3521A. Adjustable tool shelf as shown in cut above.

No. 3521B. Instrument drawer 6x13x4 inches as shown in cut above. This drawer always remains horizontal, although it is attached to top. Other drawers or trays, to suit individual needs.

See price list in back of catalog.

THE "CLAREMONT" DRAWING TABLE

With Rack and Pinion Adjustment



No. 3525

The "Claremont" is one of the most popular iron-base tables. It is very strong and rigid, and its efficiency is unequalled. It is easily adjusted, having a tilting movement from horizontal to perpendicular, and it can be adjusted in height from 30 to 45 inches. The vertical adjustment is accomplished by a rack and pinion movement. The castings are well ribbed and work smoothly. The table may be rigidly clamped at any desired height or angle. Furnished with best-quality pinewood Drawing Board No. 3450.

	Each
No. 3525. Claremont Drawing Table, with pinewood top 31x42.....	
Claremont Drawing Table, with pinewood top 33x55.....	
Claremont Drawing Table, with pinewood top 36x48.....	
Claremont Drawing Table, with pinewood top 36x60.....	
Claremont Drawing Table, with pinewood top 36x72.....	
Claremont Drawing Table, with pinewood top 42x60.....	
Claremont Drawing Table, with pinewood top 42x72.....	
Claremont Drawing Table, with pinewood top 48x72.....	
No. 3525A. Claremont Drawing Stand only, without board.....	

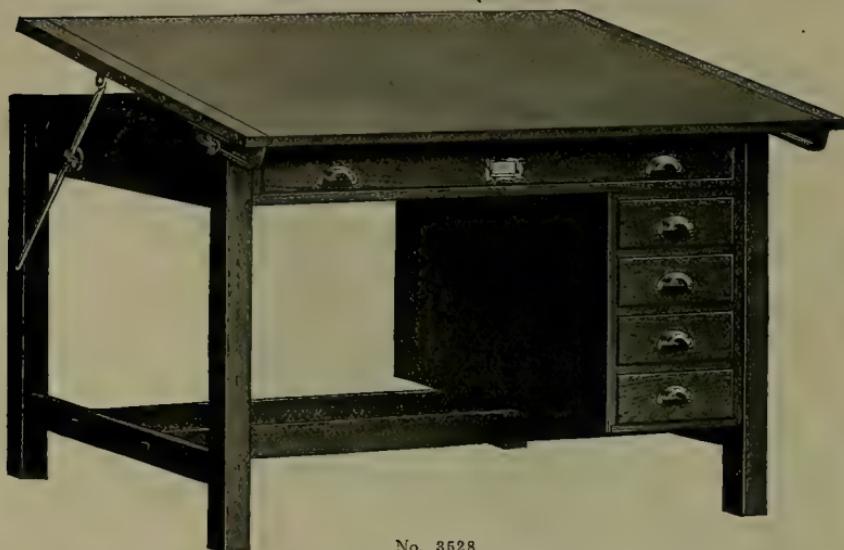
See Drafting Room Cabinet, page 418.

See Parallel Straightedge Nos. 3428-29, page 408.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

THE "RICHMOND" DRAWING TABLE



No. 3528

No. 3528. Richmond Drawing Table, height 34 in., adjustable pinewood top 36x54 in. One drawer for tracings 32x42½x2" inside, and four drawers 10x23x3½" inside, for tools and supplies
(Shipping Weight 325 lbs.)

THE "STOCKTON" DRAWING TABLE



No. 3529

No. 3529. Stockton Drawing Table, height 34 in., adjustable pinewood top 36x54 in. Six drawers for tracings 32x42½x2" inside.....
(Shipping Weight 400 lbs.)

See price list in back of catalog.

THE "FRESNO" DRAWING TABLE



No. 3530

- No. 3530. Fresno Drawing Table, height 34 in. with 3 in. raising blocks. Adjustable pinewood top 34x72 in. One drawer for tracings $37\frac{1}{2} \times 25 \times 2$ " inside and two drawers $17\frac{1}{2} \times 26 \times 3\frac{3}{4}$ " for tools and supplies.....
No. 3530S. Same as No. 3530 but with solid top
(Shipping Weight 250 lbs.)

THE "STANFORD" DRAWING TABLE



No. 3531

(Parallel Straightedge Attachment extra)

- No. 3531. Stanford Drawing Table, height 36 in. with 3 in. raising blocks. Adjustable pinewood top 34x60 in. One drawer for tracings $37\frac{1}{2} \times 25 \times 2$ " inside, and four drawers $10 \times 23 \times 3\frac{3}{4}$ " inside, for tools and supplies....
No. 3531S. Same as No. 3531 but with solid top.....
(Shipping Weight 875 lbs.)

See price list in back of catalog.

THE "BERKELEY JUNIOR" DRAWING TABLE



No. 3532

No. 3532. Berkeley Junior Drawing Table, height 34 in. with 3 in. raising blocks. Adjustable pinewood top 34×72 in. Six drawers for tracings $37\frac{1}{2} \times 25 \times 2$ " inside, and two drawers $17\frac{1}{2} \times 25 \times 3\frac{3}{4}$ " for tools and supplies

No. 3532S. Same as No. 3532 but with solid top
(Shipping Weight 300 lbs.)

THE "BERKELEY SENIOR" DRAWING TABLE



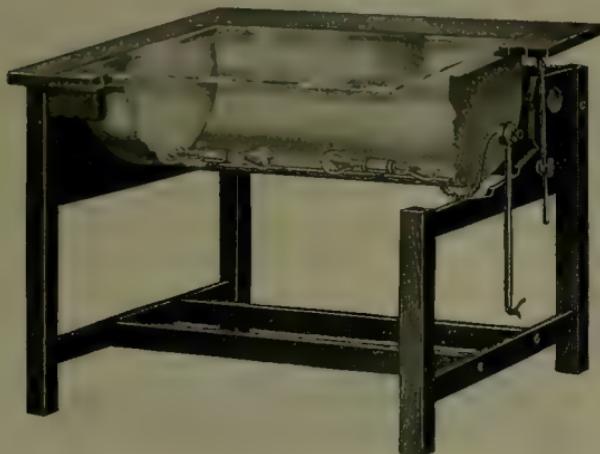
No. 3533

No. 3533. Berkeley Senior Drawing Table, height 34 in., with 3 in. raising blocks. Adjustable pinewood top 39×84 in. Six drawers for tracings $32 \times 42\frac{1}{2} \times 2$ " inside, and two drawers $20 \times 32 \times 3\frac{3}{4}$ " for tools and supplies

No. 3533S. Same as No. 3533 but with solid top
(Shipping Weight 400 lbs.)

See price list in back of catalog.

THE "SHADOWLESS" TRACING TABLE



No. 3537

Cut-away view showing interior of reflector.

Every drafting room should have at least one of these tables. With it tracings can be made accurately and at a great saving in time.

This table can be placed in the darkest corner of the room to advantage as no overhead lights are necessary. The electric lights are below the plate glass top and proper illumination is obtained by four electric lights wired with a metal moulding which bears the National Board of Fire Underwriters' stamp. The reflector being parabolic in shape gives an even illumination on the glass above, and having an aluminum bronze finish inside gives further diffusion all over the working surface with no dark spots anywhere. The fact that the electric lights are below the plate glass top and drawing eliminates all shadows and enables the draftsman to trace with a minimum of eye strain.

There is a snap switch at the end of the table which controls all the lights.

Every draftsman knows the difficulty of making a tracing over soiled blue prints or drawings. With this device the smallest figures and finest lines are made legible through the average grade of drawing paper as well as through tracing paper or cloth.

A piece of transparent celluloid placed between the glass and the drawings or tracings provides suitable material for compass points.

Drawings 24x36 or larger can be fastened with thumb tacks to the pine frame which surrounds the glass. Smaller drawings can be fastened to the glass with gummed stickers.

The top of this table is 36" x 48". It is hinged at the front and has an adjusting device at the rear. The lights and reflector are attached to the top, thereby keeping the light, reflector, and glass top always in the same relative position to each other when top is raised or lowered. Flush with the top is the plate glass tracing surface 24" x 36", the under side of which has a sandblast finish. The reflector has vent holes near the top where any surplus heat may escape, and constant use of this table shows that the glass top working surface never becomes hot.

No. 3537. Shadowless Tracing Table, height 34 in., with 3 in. raising blocks. Adjustable top 36x48 in., plate glass tracing surface 24x36 in.

See price list in back of catalog.

SECTIONAL FILING CASES

No. 3545

A cabinet for the protection and filing of your drawings, blue prints, specifications, maps, photographs, etc., is one of the most necessary articles of equipment in a drafting room, and the sectional style is by far the most popular, as it can be made to grow as your business grows.

It is built on the same plan as the well-known sectional bookcases, and is always made uniform in size and finish so that any number of sections, procured at different times, will fit perfectly.

Construction

These units are made of well-seasoned and thoroughly kiln-dried oak. The drawers are constructed with dovetailed joints. They slide in grooves, there being no rails between them. The back of each drawer is covered for a space of six inches with a thin strip to prevent drawings from curling up. Sections are held in place by means of a half-round projection on the back of the section, which the cuts do not show; and this fits into the upper section, and the front rails are bolted together. Bolting in this way prevents the rail from sagging and catching on the drawer below.



Section 32B. Oak Top.



Section 32C. Five-Drawer Section.



Section 32D. Three-Drawer Section.



Section 32EE. One Drawer Section.

See price list in back of catalog.

SECTIONAL FILING CASES



Section 32G. Low Plain Base.



Section 32H. Low Sanitary Base.



Section 32J. High Sanitary Base.



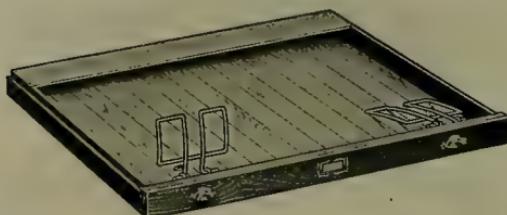
Section 32K. One large and two small Drawers.

No. 3545	Inside Length Inches	Width of Drawers In.	Depth of Drawers In.	Outside Length Inches	Width Over All Inches	Height Over All Inches	Shipping Wt. Pounds
Section							
No. 32B. Oak Cap .....	...	..	...	45½	35	3	76
No. 32C. Five Drawer Section	42½	32	2	45½	34½	14½	150
No. 32D. Three Drawer Section	42½	32	3½	45½	34½	14½	145
No. 32EE. One Drawer Section	42½	32	7	45½	34½	9¼	95
No. 32G. Plain Base .....	...	..	...	45½	34½	4	35
No. 32H. Low Sanitary Base .....	...	..	...	45½	34½	5¾	30
No. 32J. High Sanitary Base .....	...	..	...	45½	34½	22¾	70
No. 32K. Two Drawers 20x32x3¾ with Tool Tray and One Drawer 32x42½x2 .....	...	...	...	45½	34½	9¼	100

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

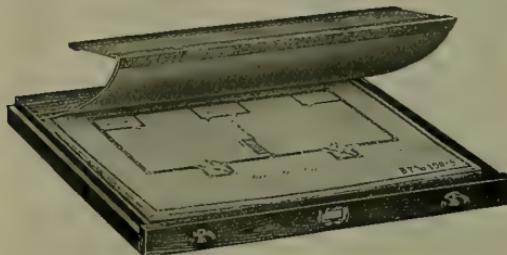
HOLD-DOWN WIRES FOR DRAWERS



No. 3546

No. 3546. Hold-Down Wires for securely holding down contents of drawer. Per pair

DRAWING PROTECTOR AND COMPRESSOR



No. 3547

No. 3547. Heavy fibre board Drawing Protector and Compressor. Size 31x42. Each

The Drawing Protector and Compressor will keep drawings, tracings and blue prints in a flat condition and prevent curling. It may be placed in the drawers at any time and requires no fastening. Fitted with hinged front flap, which allows paging through the prints to find the one desired.

Made of heavy fibre board and the front flap is hinged with heavy canvas glued and riveted to the board. On the front edge is a weight to keep the edge down.

See price list in back of catalog.

COMBINATION TABLES AND FILING CABINETS



Combination No. 3548

This combination is composed of two No. 32C, one No. 32H, a sketch box 3 inches deep with a drawing board top and a tilting adjustment, also a swing drawer with tray. The top projects over the front from 6 to 8 inches on No. 3548B, but only $2\frac{1}{2}$ " to $4\frac{1}{2}$ " on No. 3548A. Can be raised and lowered 10 inches on the level, and can be tilted to almost any desired angle. The tilting device is so arranged that it makes a very rigid outfit.
No. 3548A. With a top 37x60. Shipping weight, 475 lbs.
No. 3548B. With a top 42x72. Shipping weight, 550 lbs.



Combination No. 3549

The above combination comprises one No. 32C, one No. 32J, a swing drawer with tray, and a drawing board top, put on with slides so it can be drawn forward. This combination gives five drawers for filing purposes and is a very neat and durable outfit.
No. 3549A. With a top 37x60. Shipping weight, 325 lbs.
No. 3549B. With a top 42x72. Shipping weight, 400 lbs.

Swing Drawer and Tray included in list price of Combination Tables.

See price list in back of catalog.

STEEL SECTIONAL FILING CABINETS

These Cabinets are made of cold rolled furniture steel, they are practically indestructible. Changes of atmosphere do not swell or shrink the drawers, and they are a protection against destruction by fire.

Finished in olive green enamel, smooth and hard in surface, with a rich dull effect.



Cap No. 1835 or
No. 1853

Unit No. 1830 or
No. 1848

Unit No. 1831 or
No. 1849

Base No. 1838 or
No. 1856



Unit No. 1829 or
No. 1847



Unit No. 22-D or
No. 27-D



Unit No. 1831 or
No. 1839



Base No. 25-D or
No. 30-D

See price list in back of catalog.

STEEL SECTIONAL FILING CABINETS



Style A

Drawer
showing
patented
Hold-Down
Irons
open



Style B

Drawer
showing
patented
Hold-Down
Irons
closed

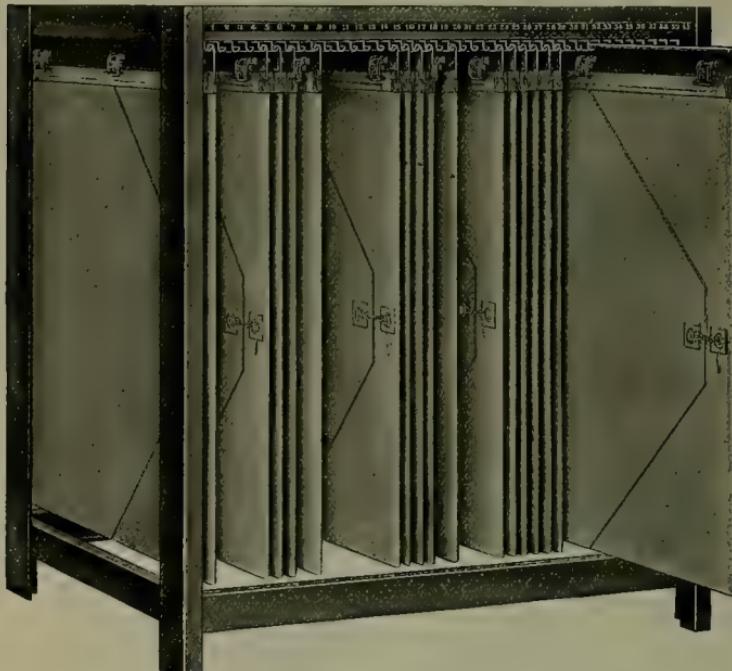
Unit No.	Description	Drawer Inside Dim.			Unit Outside Dim.			Shipping Weight	
		Length	Width	Depth	Length	Width	Height	Lbs.	
1833.	Linoleum Top Cap Unit (Small Size).	..	..	..	40 $\frac{1}{2}$	29 $\frac{1}{4}$	1 $\frac{1}{8}$	55	
1834.	Glass Top Cap Unit (Small Size).....	..	..	..	40 $\frac{1}{2}$	29 $\frac{1}{4}$	1 $\frac{1}{8}$	65	
1835.	Cap for Units 22-D-1825-1826-1830-1831	..	..	..	40 $\frac{1}{2}$	29 $\frac{1}{4}$	1 $\frac{1}{8}$	50	
22-D.	6-Drawer Unit	37	25	2 $\frac{1}{4}$	40 $\frac{1}{2}$	28 $\frac{1}{2}$	20	350	
1825.	1-Drawer Unit	37	25	7 $\frac{1}{2}$	40 $\frac{1}{2}$	28 $\frac{1}{2}$	9 $\frac{1}{8}$	150	
1826.	3-Drawer Unit—Drawers 2" deep....	37	25	2	40 $\frac{1}{2}$	28 $\frac{1}{2}$	9 $\frac{1}{8}$	200	
1829.	5-Drawer Unit with Cap (small size)....	37	25	2	40 $\frac{1}{2}$	28 $\frac{1}{2}$	16 $\frac{1}{8}$	350	
1830.	3-Drawer Unit	37	25	2	40 $\frac{1}{2}$	28 $\frac{1}{2}$	15 $\frac{3}{8}$	300	
1831.	3-Drawer Unit—Drawers 3 $\frac{1}{8}$ " deep..	37	25	3 $\frac{1}{8}$	40 $\frac{1}{2}$	28 $\frac{1}{2}$	15 $\frac{3}{8}$	250	
1836.	5-Drawer Unit with sanitary 12" Base (small size).....	37	25	2	40 $\frac{1}{2}$	28 $\frac{1}{2}$	27 $\frac{3}{8}$	365	
1837.	Flush Base for Units 22-D-1825-1826-1830-1831	..	..	..	40 $\frac{1}{2}$	28 $\frac{1}{2}$	4	60	
25-D.	Sanitary Base 12" 22-D-1825-1826-1830-1831-1829	..	..	..	40 $\frac{1}{2}$	28 $\frac{1}{2}$	12	65	
1838.	Sanitary Base, Low 6" 22-D-1825-1826-1830-1831-1829	..	..	..	40 $\frac{1}{2}$	28 $\frac{1}{2}$	5 $\frac{1}{8}$	60	
1839.	Sanitary Base, High 23" 22-D-1825-1826-1830-1831-1829	..	..	..	40 $\frac{1}{2}$	28 $\frac{1}{2}$	22 $\frac{1}{8}$	75	
1851.	Linoleum Top Cap Unit (Large Size).....	..	..	..	46 $\frac{1}{2}$	36 $\frac{1}{4}$	1 $\frac{1}{8}$	65	
1852.	Glass Top Cap Unit (Large Size).....	..	..	..	46 $\frac{1}{2}$	36 $\frac{1}{4}$	1 $\frac{1}{8}$	75	
1853.	Cap for Units 27-D-1843-1844-1848-1849	..	..	..	46 $\frac{1}{2}$	36 $\frac{1}{4}$	1 $\frac{1}{8}$	60	
27-D.	6-Drawer Unit	43	32	2 $\frac{1}{4}$	46 $\frac{1}{2}$	35 $\frac{1}{2}$	20	440	
1843.	1-Drawer Unit	43	32	7 $\frac{1}{2}$	46 $\frac{1}{2}$	35 $\frac{1}{2}$	9 $\frac{1}{8}$	200	
1844.	3-Drawer Unit	43	32	2	46 $\frac{1}{2}$	35 $\frac{1}{2}$	9 $\frac{1}{8}$	250	
1847.	5-Drawer Unit with Cap (large size)....	43	32	2	46 $\frac{1}{2}$	35 $\frac{1}{2}$	16 $\frac{1}{8}$	435	
1848.	5-Drawer Unit	43	32	2	46 $\frac{1}{2}$	35 $\frac{1}{2}$	15 $\frac{3}{8}$	375	
1849.	3-Drawer Unit	43	32	3 $\frac{1}{8}$	46 $\frac{1}{2}$	35 $\frac{1}{2}$	15 $\frac{3}{8}$	325	
1854.	5-Drawer Unit with sanitary 12" Base (large size).....	43	32	2	46 $\frac{1}{2}$	35 $\frac{1}{2}$	27 $\frac{3}{8}$	450	
1855.	Flush Base for Units 27-D-1843-1844-1848-1849-1854	..	..	..	46 $\frac{1}{2}$	35 $\frac{1}{2}$	4	75	
30-D.	Sanitary Base 12" 27-D-1843-1844-1848-1849-1854	..	..	..	46 $\frac{1}{2}$	35 $\frac{1}{2}$	12	85	
1858.	Sanitary Base, Low 6" 27-D-1843-1844-1848-1849-1854	..	..	..	46 $\frac{1}{2}$	35 $\frac{1}{2}$	5 $\frac{1}{8}$	75	
1857.	Sanitary Base, High 23" 27-D-1843-1844-1848-1849-1854	..	..	..	46 $\frac{1}{2}$	35 $\frac{1}{2}$	22 $\frac{1}{8}$	100	

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

STEEL PLAN STORAGE FILE

The old system of filing and storing sets of plans, rolled up and placed in pigeonholes, or lying flat in drawers or shelves, has never been satisfactory. The pigeonhole system takes up a good deal of unnecessary room and furthermore the rolled tracings will not lie flat for reference. Storing the sets in drawers makes them difficult to refer to and remove and occupies too much floor space.



Plan Storage File Frame No. 3561, no panels.

The Plan Storage File has been designed to eliminate the objectionable features of the old system and to take the place of out-of-date methods of storing sets of plans. A saving of 30% to 40% floor space is effected by our device. Complete sets of tracings of one hundred or more can be placed in each hanger, or two or more smaller sets can be accommodated, if desired.

Based on the hangers having a capacity of one hundred tracings each, this device has a total capacity of four thousand tracings; but more than one hundred tracings can be placed in each hanger, if the weight does not become excessive for easy handling.

Numbers are provided above each hanger from 1 to 40, and each hanger is also provided with a corresponding number, making the sets of plans easily located.

The illustration above shows the Plan Storage File Frame No. 3561 without panels or doors, but with the rack nearly filled with hangers and folders.

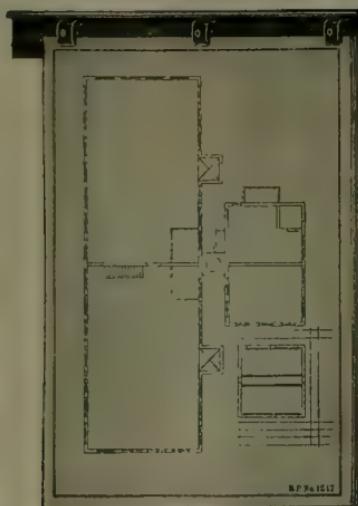
The hangers are easily removed or placed in the cabinet or frame and the tracings are readily taken out or placed in the hanger. A socket wrench is furnished with each Storage File for opening and closing the jaws of the clamps. A coil spring on the shaft of the clamps holds the jaws open when the pressure has been released. This facilitates placing the tracings in the hanger.

See price list in back of catalog.

STEEL PLAN STORAGE FILE



Hanger No. 3565A, with Folder



Hanger No. 3565B, no Folder

We show the hangers with and without the folder. When using the cabinet with all panels and doors in place, the folders are not necessary for protection as the cabinet is practically dust-proof, but the folders greatly facilitate the easy removal and placing of the tracings in the cabinet. When using the frame without the protective panels and doors we recommend using the hangers with the folders for better protection of the tracings or prints.

If a customer has on hand the hangers without the folders, he can at any time order the folders and attach them.

When ordering several of the cabinets to be placed in a row, the intervening end panels can be eliminated using only one end panel on each end of the row. The customer, however, can order the frame as shown on page 484 and later can order any number of top, bottom, end or back panels, or sets of doors. They are easily attached. The frames and cabinets are shipped knocked-down to reduce the freight charges.

No. 3560.	Plan Storage File Cabinet, with all panels and doors, and 40 hangers, with socket wrench, no folders
No. 3561.	Plan Storage File Frame, no panels or doors, with 40 hangers with socket wrench and folders
No. 3562.	Plan Storage File Frame, no panels or doors, with 40 hangers with socket wrench, no folders
No. 3563A.	End Panel, each
No. 3563B.	Back Panel, each
No. 3563C.	Top Panel, each
No. 3563D.	Bottom Panel, each
No. 3563E.	One Pair Doors
No. 3565A.	Hanger with Folder attached, takes prints 32"x48" or 32"x96", folded once
No. 3565B.	Hanger only, No Folder, takes prints 32"x48" or 32"x96", folded once
No. 3566.	Folder only, No Hanger, takes prints 32"x48" or 32"x96", folded once
No. 3567.	Socket Wrench

See price list in back of catalog.

DRAFTSMEN'S STOOLS



No. 3579

No. 3580

No. 3581

INDESTRUCTIBLE STEEL STOOLS

Made of angle steel, cross braced, olive green baked enamel with comfortable wood seat.

No. 3579A. Draftsman's Steel Stool, wood seat, 30 inches high. Each

No. 3579B. Draftsman's Steel Stool, wood seat, 36 inches high. Each

Other heights can be furnished on special order; also steel stools with back.

WOODEN STOOLS

Each

No. 3580A. Draftsman's Stool, wood seat, 30 inches high.....

No. 3580B. Draftsman's Stool, wood seat, 36 inches high.....

No. 3580D. Draftsman's Stool, cane seat, 36 inches high.....

No. 3581A. Draftsman's Stool, wood seat, adjustable from 30 to 35 inches high

No. 3581B. Draftsman's Stool, cane seat, adjustable from 30 to 35 inches high

No. 3582A. Draftsman's Stool, wood seat, adjustable from 30 to 35 inches high, with ring for foot rest.....

No. 3582B. Draftsman's Stool, cane seat, adjustable from 30 to 35 inches high, with ring for foot rest.....

FELT STOOL COVERS

No. 3585. Brown Felt Stool Covers. Each.....

Felt Stool Covers save the clothes and prevent shine on the trousers. Should be on every stool.

See price list in back of catalog.

DRAWING BOARD AND LIBRARY PASTES



No. 3600



No. 3605

- No. 3600.** Higgins' Drawing Board Mucilage. A novel semi-fluid adhesive of great strength and body, especially prepared for sticking paper to the drawing board.
In glass, screw-capped jars— 3 oz. 6 oz. 14 oz. $\frac{1}{2}$ gal. Gal.
Each
- No. 3605.** Higgins' Office Paste.
In glass, screw-capped jars—
Each

MUCILAGE AND GLUE



No. 3610



No. 3612

- No. 3610.** Higgins' Taurine Mucilage. A new, clear, non-corrosive, non-sedimentary mucilage. Stronger, catches quicker and dries faster than other mucilages, and is of pleasant odor.
In bottles, with brush—
Each
- No. 3612.** Higgins' Vegetable Glue.
In cans—
Each

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

HIGGINS' DRAWING INKS

Made in Black and the Following Colors:

Blue	Carmine	Orange	Violet
Brick Red	Green	Scarlet	Yellow
Brown	Indigo	Vermilion	White

WATERPROOF DRAWING INK



No. 3618

- No. 3618.** Higgins' Waterproof Drawing Ink, black or colors, $\frac{3}{4}$ -oz. bottle
- No. 3618HP.** Higgins' Waterproof Drawing Ink, black or colors, $\frac{1}{2}$ -pint bottle
- No. 3618P.** Higgins' Waterproof Drawing Ink, black or colors, 1-pint bottle
- No. 3618Q.** Higgins' Waterproof Drawing Ink, black or colors, 1-quart bottle

GENERAL DRAWING INK

The General Drawing Ink No. 3625 (black only) is soluble and is the best for India Ink tints and washes.

- No. 3625.** Higgins' General Drawing Ink, black only, $\frac{3}{4}$ -oz. bottle
- No. 3625HP.** Higgins' General Drawing Ink, black only, $\frac{1}{2}$ -pint bottle
- No. 3625P.** Higgins' General Drawing Ink, black only, 1-pint bottle
- No. 3625Q.** Higgins' General Drawing Ink, black only, 1-quart bottle

EMPTY INK BOTTLES AND CORKS WITH QUILLS

Doz. Each

- No. 3630.** Empty Drawing Ink Bottles, $\frac{3}{4}$ -oz., with quill filler.

- No. 3631.** Extra Corks with quill fillers for Drawing Ink Bottles

HOW TO DILUTE THE INKS

If the black inks should require to be thinned or diluted, use distilled water with a little aqua ammonia—four drops to the ounce of water. To dilute the colored inks use distilled water only. Never add any acid or mix with other inks.

See price list in back of catalog.

ALCO WATERPROOF DRAWING INK



No. 3632

We can justly recommend ALCO WATERPROOF DRAWING INK, black and in colors, as the best ink obtainable on the market. It is made on entirely new principles. The black ink is unequalled in density, yet exceptionally smooth flowing and free from any foreign matter to interfere with the smoothness of flow from the pen. The colors are made with equal care and may be mixed to produce any desired shade or tint.

ALCO WATERPROOF DRAWING INK, black and in colors, is absolutely waterproof when dry and washes may be freely applied over the drawing without the moisture in the least affecting the lines.

Made in Black and the Following Colors:

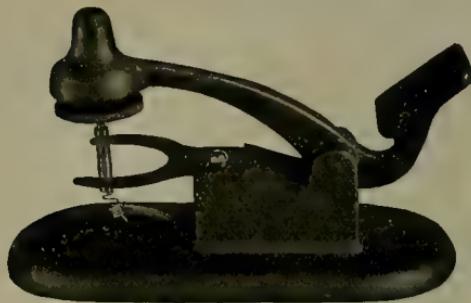
Yellow	Blue	Vermilion	Orange
Violet	Brown	Carmine	Green
Scarlet	Indigo	Brick Red	White

- No. 3632.** Alco Waterproof Drawing Ink, black or in colors,
 $\frac{3}{4}$ -oz. bottle
- No. 3632HP.** Alco Waterproof Drawing Ink, black or in colors,
 $\frac{1}{2}$ -pint bottle
- No. 3632P.** Alco Waterproof Drawing Ink, black or in colors,
1-pint bottle
- No. 3632Q.** Alco Waterproof Drawing Ink, black or in colors,
1-quart bottle

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

INK BOTTLE HOLDERS



No. 3635

ALTENEDER'S DRAFTSMAN'S PEN-FILLING INKSTAND

This accessory enables the draftsman to fill his pen in the shortest possible time, and by the use of one hand alone, leaving the other at liberty to hold the T-square, triangle, etc. It will serve as a paperweight and the stand being sufficiently heavy offers a stability the need of which is so strongly felt when working without a holder for the bottle. Provided with an automatic stopper, most efficient in preventing evaporation, and the new form of dipper will instantly and positively deliver an ample and uniform charge with no tendency whatever to ink the outside of the blades. Made of cast iron, japanned.

No. 3635. Alteneder's Draftsman's Pen-Filling Inkstand. Each.....



No. 3636

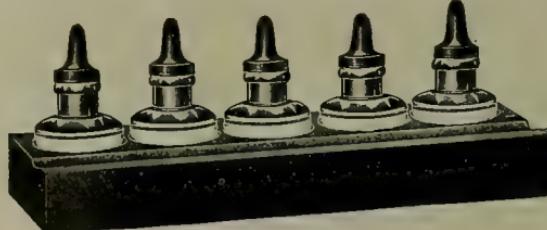


No. 3638

No. 3636. The "Clover" Ink Bottle Holder, for three bottles. Each..

No. 3638. Iron Ink Bottle Holder and Paperweight. Each.....

Iron Ink Bottle Holder No. 3638 is of neat design and simple construction. Two lugs attached to the top are inserted in two openings of the base and the top is given a quick turn, securely clamping it to the base. The holder will accommodate any standard $\frac{3}{4}$ -oz. ink bottle. Oxidized copper finish.



No. 3640

No. 3640. Drawing Ink Tray, for five bottles. Each.....

See price list in back of catalog.

CHINESE OR INDIAN INK IN STICKS



- | | | |
|------------|---|------|
| No. 3645A. | Oval, lion head, 2½ inches long..... | Each |
| No. 3645B. | Oval, lion head, 3¼ inches long..... | |
| No. 3645E. | Oblong, gilt figures, 3⅓ inches long..... | |

SLATE INK SLABS

These Slate Ink Slabs are most practical for rubbing up Chinese or Indian Ink Sticks quickly and uniformly. At one end is a well to allow convenient filling of pen, furnished with hardwood cover.

- | | | |
|-----------|---|------|
| No. 3651. | Slate Ink Slab with hardwood cover. Size 5½x2½ inches.. | Each |
|-----------|---|------|

ETERNAL WRITING INK

A fine fluent Carbon Writing Ink for general use. Black from the pen and eternally remains so, proof to age, air, sunshine and chemicals.



No. 3662

- | | |
|-----------|--|
| No. 3662. | Higgins' Eternal Ink, 2-oz. bottle. Each |
|-----------|--|

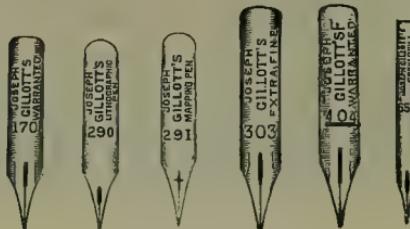
See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

STEEL PENS

For Drawing and Lettering

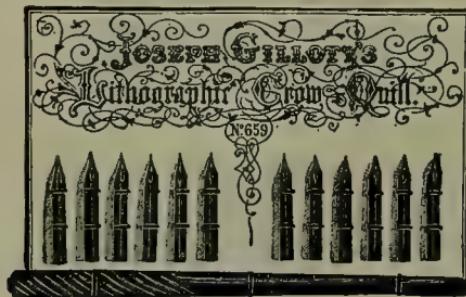
JOSEPH GILLOTT'S STEEL PENS



In One-Gross Boxes—Pens Loose

Gross Doz.

No. 170.	Ladies' Pen, extra fine points.....	
No. 290.	Lithographic and Drawing Pen, superfine points.....	
No. 291.	Mapping, Drawing and Engraving Pen.....	
No. 303.	The Original Extra Fine Pen.....	
No. 404.	Public Pen with bead, fine points	
No. 659.	Crow Quill, superfine drawing points.....	



In One-Gross Boxes—12 Pens on a Card, with Penholder

Gross Doz.

No. 290.	Lithographic and Drawing Pen, superfine points...	
No. 291.	Mapping, Drawing and Engraving Pen.....	
No. 659.	Crow Quill, superfine drawing points.....	
No. 850.	Long Shoulder Crow Quill, superfine points.....	
No. 1000.	Tit Quill. The finest points.....	

See price list in back of catalog.

HUNT'S AMERICAN STEEL PENS

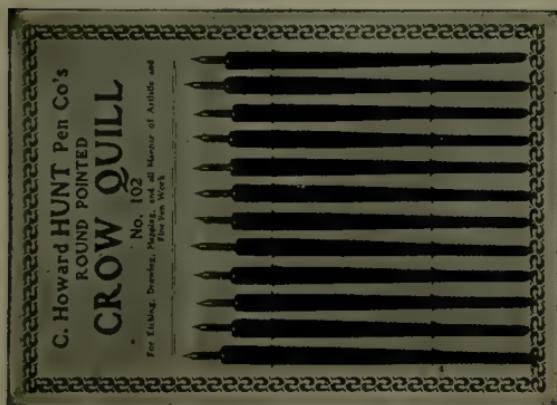


In boxes—loose.

Gross Doz.

- No. 22. Extra Fine, for fine and ornamental writing.
 No. 56. School, extra fine point, flexible action.
 No. 71. Music Writer, has two slits forming three points.
 No. 99. Drawing, special fine point for draftsmen.
 No. 100. Artist, very delicate for experts.
 No. 101. Imperial, very flexible for ornamental writing.
 No. 102. Crow Quill, for draftsmen and artists.
 No. 107. Hawk Quill, exceeding fine but stiffer than No. 102.

HUNT'S PENS WITH HOLDERS



▼ No. 102.
 Crow Quill, 12 pens,
 each with holder, on
 card. Per gross (12
 cards)
 Per doz. (12 pens
 and holders)
 Each (1 pen and hold-
 er)

No. 107.
 Hawk Quill, 12 pens,
 each with holder, on
 card. Per gross (12
 cards)
 Per doz. (12 pens
 and holders)
 Each (1 pen and hold-
 er)

HUNT'S AMERICAN BOWL POINTED PENS



- No. 512. Bowl Point, extra fine point.....
 No. 513. Bowl Point, unexcelled for smoothness, fine point.....
 No. 513EF. Bowl Point, extra fine.....
 No. 514. Bowl Point, medium fine, falcon shape.....

Gross Doz.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

LEONHARDT'S BALL POINTED PENS



No. 506F



No. 516EF



No. 526

Note: F denotes Fine, EF denotes Extra Fine.

Leonhardt's Ball Pointed Pens.

	Gross Doz.
Nos. 506F, 506EF, 516F, 516EF and 526

SPENCERIAN STEEL PENS

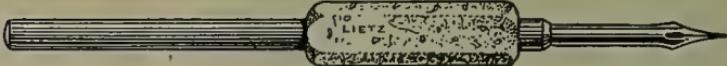


No. 1 College, fine point, double elastic action.
Per gross..... Per doz.....



No. 9 Bank, long and flexible point.
Per gross..... Per doz.....

CORKO CROW QUILL PENS

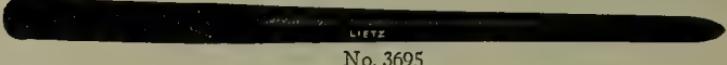


No. 3690

Gross Doz. Each

No. 3690. Crow Quill Pens with improved holders with cork finger piece. One dozen pens and one dozen holders on card

PENHOLDERS FOR GILLOTT'S AND HUNT'S PENS



No. 3695



No. 3697

Doz. Each

No. 3695. Ebony Penholder for Crow Quill Pens, extra fine..

No. 3696. Ebony Penholder for Crow Quill Pens, plain.....

No. 3697. Polished Cedar Penholder for Mapping Pens.....

See price list in back of catalog.

ROUND WRITING PENS



No. 3725

No. 3725. Round Writing Pens, single pointed. (Order by number.)
 Gross $\frac{1}{4}$ gross Doz.
 Any one kind of the above Nos.



No. 3725A. Assortment of 12 Single Pointed Pens on card. Per card.

TWO-LINE PENS



Gross $\frac{1}{4}$ gross Doz.

No. 3727. Two-line Pens, Hunt's No. 72.

INK RESERVOIR AND HOLDERS FOR ROUND WRITING PENS



No. 3730

No. 3731

Box of 10 Each

No. 3730. Inkholders for Single and Double Pointed Pens....

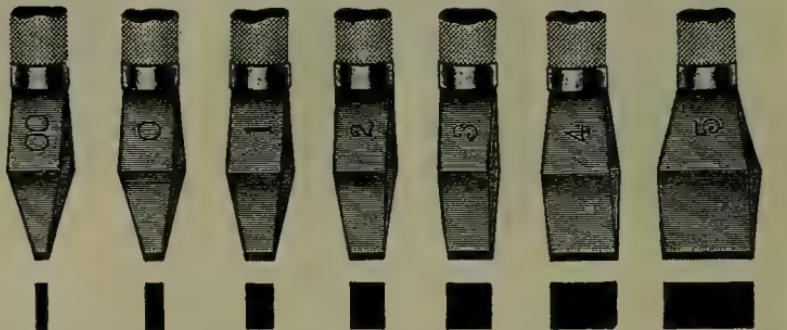
No. 3731. Penholders for Round Writing Pens, double ends....

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

AUTOMATIC MARKING PENS

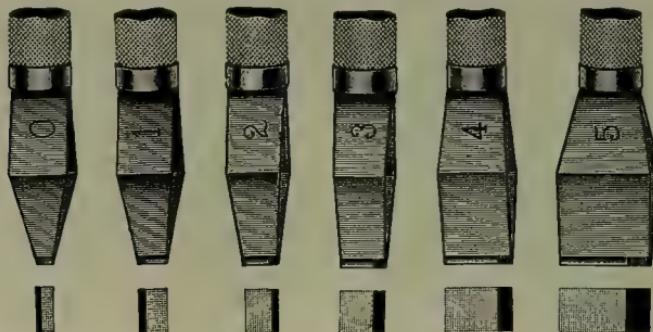
These Pens make a solid plain mark, full strength of the color used.



No. 3737. Automatic Marking Pens, Nos. 00, 0, 1, 2, 3, 4, 5. Each
Width of Nib, inches 00 0 1 2 3 4 5 Each

AUTOMATIC SHADING PENS

These Pens make a mark of two shades at a single stroke of the pen from one color ink.



No. 3738. Automatic Shading Pens, Nos. 0, 1, 2, 3, 4, 5. Each
Width of Nib, inches 0 1 2 3 4 5 Each

BOOKS ON PEN LETTERING

No. 3739. Practical Compendium of Commercial Pen Lettering and Designs. Size of book 8x11 inches, 100 pages, neatly bound. 122 plates of pen alphabets, designs and show card layouts, corners, borders, scrolls with complete instructions for each. Per copy.....

No. 3740. Textbook of Modern Pen Lettering, short simple methods with modern lettering pens. Size of book 6x9 inches, 56 pages, neatly bound. Profusely illustrated with many selections of practical alphabets, decorative borders, background stunts and artistic designs. Per copy.....

For other books on lettering see page 484.

See price list in back of catalog.

LEROY LETTERING AND DRAWING PEN



The draftsman will find the "Leroy" unequaled for neat, clean-cut Lettering, Numbering and Ruling—either freehand or guided.

There are 7 Points, of the widths as shown. Each Point constitutes a miniature inkwell, feeding downward to the working surface.

These pen points are interchangeable. They fit into a swivel socket. This part in turn fits an ordinary penholder.

A proper working angle is secured and maintained by an adjusting screw.

The entire set of 7 Points, Cleaner and Holder comes in a small, compact wooden box.

Considerable speed can be obtained and a little practice brings very gratifying results.

Use the Tube-Pen either Freehand or Guided. Unlike other pens, the Tube is well adapted to follow the edge of a Tee Square.

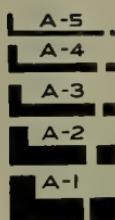
Ideal Block-Type letters and clear Blue Prints are obtained from the Tube-Pen's work.

No. 3741. Leroy Tube Lettering Pen Outfit, consisting of 7 points, swivel socket and cleaner, all contained in compact wooden box. Outfit complete...

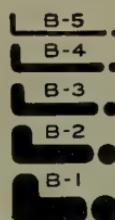
See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

SPEEDBALL LETTERING PENS



No. 3742—Style A
Square Points

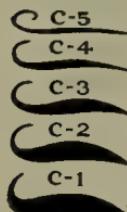


No. 3742—Style B
Round Points

Showing thickness of line of various sizes.

The Speedball Lettering Pen produces a stroke of uniform width throughout, when drawn in any direction, square terminals with "Style A" Pens and round terminals with "Style B" Pens. The ink flow is under automatic control by double reservoir fountain and tip-retainer over the extreme point of bent up section which forms the marking point. This feature prevents any excess flood of ink or color on the strokes. To fill reservoir, simply dip in the ink like an ordinary pen.

Speedball Lettering Pens are the fastest and most easily operated broad-stroke pens on the market. Will work in any India ink or opaque water color properly diluted to flowing consistency. The small sizes will contain enough ink to make an entire alphabet.



No. 3742—Style C.



Speedball Pens, style C, will produce letter styles of individual character and distinction in close imitation of the finest small brush work at many times the speed.

Doz. Each

No. 3742A. Speedball Lettering
Pens, square points, Nos. 1-5..

No. 3742B. Speedball Lettering
Pens, round points, Nos. 1-5..

Doz. Each

No. 3742C. Speedball Lettering Pens, Nos. 1-5.....

SPEEDBALL PEN ASSORTMENTS

Per box

No. 3742SA. Assortment of 5 square point Speedball Pens,
one each 1-5 in box

No. 3742SB. Assortment of 5 round point Speedball Pens,
one each 1-5 in box

No. 3742SC. Assortment of 5 style C Speedball Pens, one
each 1-5 in box

See price list in back of catalog.

MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS THE A. LIETZ COMPANY
SAN FRANCISCO, U. S. A.

PENHOLDERS



Nos. 3746-47

	Doz.	Each
No. 3746. Cedar finish, medium size, hard rubber tip.....		
No. 3747. Cedar finish, large size, hard rubber tip.....		



No. 3749

No. 3749. Medium size, fluted rubber tip, black finish.....
--



No. 3751

No. 3751. Medium size, cork tip, natural finish.....



No. 3752

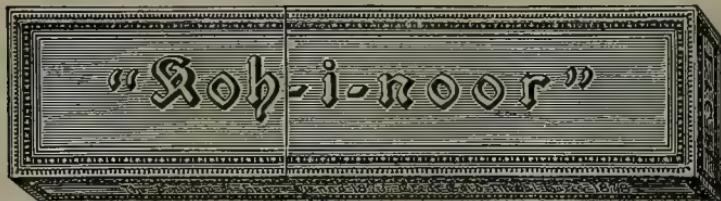
No. 3752. Medium size, all rosewood, natural finish.....

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS

SAN FRANCISCO, U. S. A.

KOH-I-NOOR DRAWING PENCILS



No. 3760

Per gross Dozen Each

- No. 3760.** "Koh-i-noor" Drawing Pencils, hexagon, yellow polish, in the following degrees: 9H, 8H, 7H, 6H, 5H, 4H, 3H, 2H, H, F, HB, B, 2B, 3B, 4B, 5B, 6B.....



No. 3762

Each

- No. 3762.** "Koh-i-noor" Artists' Pencil, with movable leads, 8H, 7H, 6H, 5H, 4H, 3H, 2H, H, F, HB, B, 2B, 3B, 4B, 6B.....



No. 3765

Per box

- No. 3765.** "Koh-i-noor" Artists' Leads, in cedarwood boxes of 6 leads, 8H, 7H, 6H, 5H, 4H, 3H, 2H, H, F, HB, B, 2B, 3B, 4B, 6B.....

VENUS DRAWING PENCILS



No. 3770

Per gross Doz. Each

- No. 3770.** Venus American Drawing Pencils, hexagon, mottled green polished cedar, in the following degrees: 9H, 8H, 7H, 6H, 5H, 4H, 3H, 2H, H, F, HB, B, 2B, 3B, 4B, 5B, 6B

See price list in back of catalog.

MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS

THE A. LIETZ COMPANY

SAN FRANCISCO, U. S. A.

CASTELL DRAWING PENCILS



No. 3776

Per Gross Doz. Each

- No. 3776.** Castell Drawing Pencils, hexagon, green polish, in the following degrees: 9H, 8H, 7H, 6H, 5H, 4H, 3H, 2H, H, F, HB, B, 2B, 3B, 4B, 5B, 6B.....

- No. 3778.** Castell Flat Pencils, especially adapted for Fieldbook use. In the following degrees: 4H, 2H and HB
*Illustrated on page 206.

ELDORADO DRAWING PENCILS



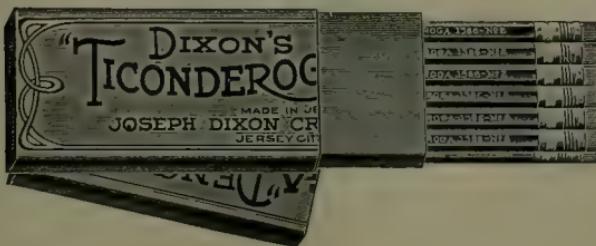
No. 3780

Per Gross Doz. Each

- No. 3780.** ELDORADO DRAWING PENCILS, hexagon, yellow polish, in the following degrees: 8H, 7H, 6H, 5H, 4H, 3H, 2H, H, F, HB, B, 2B, 3B, 4B.....

TICONDEROGA PENCILS

With red rubber tips.



No. 3788

Per Gross Doz. Each

- No. 3788.** Ticonderoga Pencils, hexagon, cornerless, yellow finish, gilt ferrule with red rubber tip, in the following grades: 1, 2, 3, 4

EAGLE DRAFTING PENCILS



No. 3795

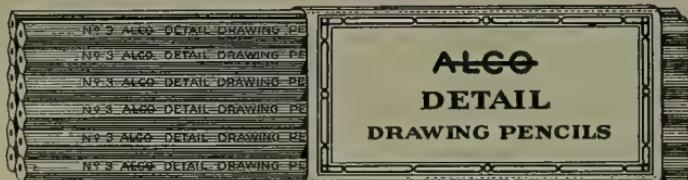
Per Doz. Each

- No. 3795.** Eagle Drafting Pencils, round, extra thick black lead.....

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

ALCO DETAIL DRAWING PENCILS



No. 3796

Per gross. Per doz.

No. 3796. ALCO Detail Drawing Pencils, hexagon, in
the following grades: 1 or B, 2 or HB, 3 or F, 4
or 2H

The Alco Detail Pencils are uniformly graded, free from grit, and are an excellent pencil for sketching and drawing details. We recommend them highly.

COPYING PENCILS
HARDTMUTH'S "MEPHISTO" COPYING PENCILS



No. 3800

Per gross Per doz. Each

No. 3800A. Hardtmuth's Mephisto Copying Pencils. No. 73 B, hard

No. 3800B. Hardtmuth's Mephisto Copying Pencils. No. 73 B, medium



No. 3801

Per gross Per doz. Each

No. 3801. Hardtmuth's "Mephisto" (77) Copying Ink Pencils, with red tip, or mouth-piece

COLORED COPYING PENCILS



Nos. 3802-3

Per gross Per doz. Each

No. 3802. Dupligraph Red Copying Pencil.

No. 3803. Dupligraph Green Copying Pencil

See price list in back of catalog.

LISTO AUTOMATICALLY PERFECT PENCILS

Made of Listolite, neither wood, metal nor rubber, but a distinct composition never before used in pencil making. It is featherlight, flexible and pleasant to the touch. Extraordinarily durable. Colors are permanent and untarnishable. Quick and easy to load.



No. 3805

Doz. Each

No. 3805. (Style 10.) Listo Lead

Pencil, $5\frac{1}{2}$ inches long, with clip,
assorted fancy colored barrels, in
the following grades: B, HB, F, H

Doz. Each

No. 3806. (Style 210.) Listo Lead

Pencil, 4 inches long with ring
bow, assorted fancy colored bar-
rels, in the following grades: B,
HB, F, H

**LISTO COLORED CHECKING
PENCILS**

Doz. Each

No. 3807. (Style 20.) Listo Col-
ored Checking Pencil, 6 inches long
with clip, with checking crayons in
the following colors: Yellow, White,
Blue, Red, Green, Brown, Black...

**EXTRA LEADS FOR LISTO
PENCILS**

Per doz.
boxes

Per
box

No. 3808. Extra boxes of Graphite
Leads for Pencils Nos. 3805-
3806, 1 dozen leads to the box in
the following grades: B, HB,
F, H

Per doz.
boxes

Per
box

No. 3809. Extra boxes of Checking
Colored Leads for Checking Pen-
cils No. 3807, 10 leads to the box
in the following colors: Yellow,
White, Blue, Red, Green, Brown,
Black



No. 3807

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

PENCIL POINT PROTECTORS AND PENCIL LENGTHENERS



No. 3810

Dozen Each

No. 3810. "ALCO" one-piece Pencil Lengthener, aluminum.....

"ALCO" one-piece Pencil Lengthener No. 3810 is most efficient. Made of one piece, eliminating all chances of any part becoming loose or wobbly. The Pencil stubs may be screwed in at either end, or one end will accommodate an eraser. The threads will grip the pencil tightly and pencil and lengthener will be as firm as one piece.

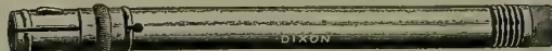


VAN DYKE PENCIL LENGTHENER

No. 3815

Per doz. Each

No. 3815. Van Dyke Pencil Lengthener, hexagon, yellow,
polished handle, long nickelized ferrule with
screw end



No. 3817

Per doz. Each

No. 3817. All Metal Pencil Lengthener, nickel plated, $4\frac{1}{8}$
inches long, with slide and red rubber.....

PENCIL POINT PROTECTORS



No. 3820

Per doz. Each

No. 3820. Pencil Point Protector, round with eraser....

RUBBER PENCIL TIPS



No. 3828



No. 3829

Gross. Per doz.

No. 3828. Hexagon Rubber Pencil Tips, red rubber.....

No. 3829. Round Rubbers for Pencil Point Protectors,
red rubber

See price list in back of catalog.



No. 3830

PENCIL CLIPS

No. 3830. Metal Pencil Clip, made of heavy brass, nickel plated, for all standard pencils....

Per gross..... Per doz..... Each.....

No. 3831. Metal Pencil Clip, large for thick lumber pencils or fountain pen.

Per gross..... Per doz..... Each.....



No. 3831

PENCIL POCKETS

Worn inside the pocket, with metal spring to attach. Also suitable for holding pocket scales.

No. 3833. Imitation Leather Pencil Pocket.

Per doz..... Each.....

PENCIL POINTERS



No. 3844

No. 3844. Steel Lead Pencil File and Tack Lifter, 6 inches. Each....

A convenient little tool, consisting of a steel file with a steel tack lifter at the end, black wooden handle.



No. 3845

No. 3845. Sandpaper Pencil Pointer, 1 $\frac{1}{4}$ x4 inches, with handle. Each..

No. 3846. Emery Paper Pencil Pointer, 1 $\frac{1}{4}$ x4 inches, with handle. Ea.

See price list in back of catalog.

PENCIL SHARPENERS



No. 3847

No. 3847. The Chicago Giant Pencil Sharpener. Each

The Chicago Giant Pencil Sharpener sharpens every pencil and crayon, from the smallest to the largest. Automatically stops cutting when the point is produced. Will not break the leads.



No. 3849

DEXTER PENCIL SHARPENER WITH SPECIAL DRAFTSMEN'S CUTTERS



No. 3849DC. Same as No. 3849, but with special draftsmen's cutters. Each

The draftsmen's cutters are specially ground to cut away the wood only as shown in illustration, leaving the lead exposed, which may be pointed on file or sandpaper to suit the requirements of the user.

See price list in back of catalog.

COLORED PENCILS

A. W. FABER'S POLYCHROME CRAYONS



Yellows

- 2 Zinc Yellow
- 3 Lemon Cadmium
- 4 Light Chrome
- 5 Light Cadmium
- 6 Dark Cadmium
- 7 Naples Yellow
- 8 Dark Chrome
- 9 Orange

Blues

- 21 Light Blue
- 22 Sky Blue
- 23 Cobalt Blue
- 24 Ultramarine
- 25 Paris Blue
- 26 Prussian Blue
- 27 Indigo
- 28 Delft Blue

Reds

- 31 Pink Madder Lake
- 32 Madder Carmine

- 33 Rose Pink
- 34 Carmine Lake
- 35 Carmine Extra Fine
- 36 Scarlet Lake
- 37 Saturn Red
- 38 Pale Vermilion
- 39 Dark Vermilion
- 46 Venetian Red
- 47 Brick Red
- 48 Terra Cotta
- 49 Indian Red
- 50 Burnt Carmine

- #### Various
- 1 White
 - 29 Red Violet Lake
 - 30 Blue Violet Lake
 - 57 Light Gray
 - 58 Neutral Tint
 - 59 Payne's Gray
 - 60 Ivory Black

- #### Greens
- 10 Terre Verte
 - 11 Olive Green

- 12 Mineral Green
- 13 French Green
- 14 Green Bice
- 15 Sap Green
- 16 Hooker's Green No. 1
- 17 Hooker's Green No. 2
- 18 Verdian
- 19 Vegetable Green
- 20 Prussian Green

Browns

- 40 Light Ochre
- 41 Raw Sienna
- 42 Gold Ochre
- 43 Burnt Yellow Ochre
- 44 Brown Ochre
- 45 Burnt Sienna
- 51 Raw Umber
- 52 Bistre
- 53 Van Dyke Brown
- 54 Burnt Umber
- 55 Sepia
- 56 Warm Sepia

Doz. Each

No. 3850. A. W. Faber's Polychrome Crayons, listed above..

ASSORTED BOXES

- No. 3850-12.** Box containing assortment of 12 Polychrome Pencils..
- No. 3850-24.** Box containing assortment of 24 Polychrome Pencils..
- No. 3850-36.** Box containing assortment of 36 Polychrome Pencils..
- No. 3850-60.** Box containing assortment of 60 Polychrome Pencils..

See price list in back of catalog.

DIXON'S BEST COLORED PENCILS



No. 3852

Dixon's Best Colored Pencils are made in the following colors:

White	Pink	Purple	Sepia
Orange	Lemon Yellow	Terra Cotta	Red
Olive Green	Blue	Carmine	Light Green
Indigo	Black	Golden Yellow	Azure
Burnt Ochre	Lake Red	Sky Blue	Yellow Ochre
Gray	Green	Violet	Brown

Per doz. Each

No. 3852. Dixon's Best Colored Pencils, listed above.....

ASSORTED BOXES

No. 3852-7. Box containing assortment of 7 Dixon's Colored Pencils

No. 3852-12. Box containing assortment of 12 Dixon's Colored Pencils

No. 3852-24. Box containing assortment of 24 Dixon's Colored Pencils

BLAISDELL CHINA MARKING PENCILS



No. 3858

These pencils are specially made for marking on glass, metal or materials with a glossy surface. Doz. Each

No. 3858. Blaisdell China Marking Pencils in the following colors:
Black, Red, Blue and Green.....

THIN LEAD OFFICE COLORED PENCILS

With colored leads as thin as ordinarily contained in the usual black lead pencil.



No. 3860, round

Per gross Per doz. Each

No. 3860A. Dixon's Thin Lead Colored Pencils, Red....

No. 3860B. Dixon's Thin Lead Colored Pencils, Blue...



No. 3861, Hexagon

Per gross Per doz. Each

No. 3861A. American Thin Lead Colored Pencils, Red....

No. 3861B. American Thin Lead Colored Pencils, Blue...

No. 3861C. American Thin Lead Colored Pencils, Yellow

See price list in back of catalog.

MAMMOTH SIZE COLORED PENCILS

These pencils are excellent for general office work, checking and marking.

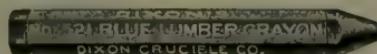


No. 3862 Round

Per Gross Per Doz. Each

- No. 3862A.** Mammoth Size Colored Pencils, red.....
No. 3862B. Mammoth Size Colored Pencils, blue.....
No. 3862X. Mammoth Size Colored Pencils, red and
blue

No. 3862X contains blue lead in one end and red in other.

DIXON'S LUMBER CRAYONS

No. 3871

Paper Covered

Dozen

- No. 3871A.** Dixon's Lumber Crayons, paper covered, red.....
No. 3871B. Dixon's Lumber Crayons, paper covered, blue.....
No. 3871C. Dixon's Lumber Crayons, paper covered, yellow.....
No. 3871D. Dixon's Lumber Crayons, paper covered, carbon black....

NICKEL HOLDER FOR LUMBER CRAYONS

No. 3873

- No. 3873.** Nickel Holder for Lumber Crayons.....

Each

SOAPSTONE CRAYON

No. 3875

- No. 3875.** Metalworker's Soapstone Crayons, 5x1/4x1/2 in.....

Dozen

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

CLEANING ERASERS



No. 3880C

Each

No. 3880A.	Sponge Rubber with solid back, 1 x1x1.....	
No. 3880B.	Sponge Rubber with solid back, 1½x2x1.....	
No. 3880C.	Sponge Rubber with solid back, 3 x2x1.....	
No. 3880D.	Sponge Rubber with solid back, 6 x4x1.....	



No. 3883



No. 3884

Dozen Each

No. 3883A.	Artgum, 1½x1½x1½ inches	Dozen	Each
No. 3883B.	Artgum, 2 x1 x1 inches		
No. 3883C.	Artgum, 2½x1½x1½ inches		
No. 3883D.	Artgum, 3 x2 x1 inches		
No. 3883E.	Artgum, 3 x3 x2 inches		

ARTGUM OR PLASTIC OR KNEADED RUBBER

Dozen Each

No. 3884A.	Kneaded Rubber No. 1222, small	Dozen	Each
No. 3884B.	Kneaded Rubber No. 1224, large		

Both sizes packed 3 dozen in a box.



No. 3885

Soft and pliable, and will erase pencil marks easily and without injury to Tracing Paper or any other delicate drawing material.

No. 3885.	Gray Pliable Rubbers.	60	40	30	24	20	16	12	8	4
Pieces to pound—										
Each										

Per 1-pound box

See price list in back of catalog.

DRAFTSMEN'S ERASERS



This Rubber is soft and pliable, and will be found to erase pencil marks easily and without injury to either tracing paper or any other delicate drawing material.

No. 3888A. Pink Pearl Eraser No. 100, medium..... Dozen Each
 No. 3888B. Pink Pearl Eraser No. 101, large.....

Note: No. 100 Medium Pink Pearl Erasers packed 2 dozen in a box.



No. 3892A. Emerald Eraser No. 111, small, double bevel.....
 No. 3892B. Emerald Eraser No. 211, large, double bevel.....



No. 3894A. Ruby Eraser No. 112, small, double bevel.....
 No. 3894B. Ruby Eraser No. 212, large, double bevel.....

For Rubber Tips for pencils or pencil lengtheners see page 454.



No. 3895



No. 3896

No. 3895. Circular Pencil and Ink Eraser No. 1080,..... Dozen Each
 No. 3896. Comet Circular Eraser No. 1087; same as No. 1080
 with brush

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

ERASERS



No. 3898A. Union Ink and Pencil Eraser No. 110, small..... Dozen Each



No. 3903

No. 3903. Van Dyke Soft Ink Eraser, 2 3/4x1 1/8 inches, No. 6500..... Dozen Each

SEYMOUR MOTOR DRIVEN ERASER



No. 3905

An electrically driven device designed to eliminate the objectionable features of cable machines.

The erasing and power elements are combined in one unit weighing less than two pounds. In use the entire weight rests on the drawing surface. The machine is held at an angle of 45 degrees. With this machine a period may easily be removed without disturbing surrounding data. When the current is on the ease with which it can be operated is surprising.

The revolving motor armature produces a gyroscopic action which has a marked tendency to hold the device at the operating angle. In addition to this, the direction of rotation is such that the friction developed by erasing gives the handle a tendency to pull upward. This is counteracted by the weight of the motor held on the operating angle.

Since the whole hand grasps the handle and the weight is on the drawing surface, it is only necessary to guide the machine. No cramps to the fingers result from extended use.

The starting device and variable speeds are controlled by a slight movement of the thumb of the hand in which the machine is held.

The eraser holder is provided with a compression ring that slides over six beveled jaws.

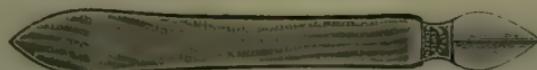
No. 3905. Seymour Motor Driven Eraser, complete with 6 dozen assorted erasers. Each

No. 3906-6. Extra Erasers for Motor Driven Eraser, soft gray. Per gross.....

No. 3906-7. Extra Erasers for Motor Driven Eraser, soft red. Per gross.....

No. 3906-12. Extra Erasers for Motor Driven Eraser, abrasive gray. Per gross

STEEL ERASERS



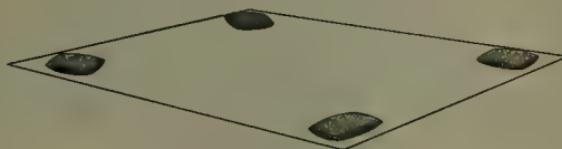
Style "A"



Style "B"

- No. 3909. Steel Eraser, style A, cocoa handle.....
No. 3910. Steel Eraser, style B, cocoa handle.....
No. 3911. Steel Eraser, style B, bone handle.....

CHART AND PAPER WEIGHTS



No. 3913

- No. 3913. (Old No. 3933.) Paper Weights, canvas bags loaded with shot, $1\frac{1}{2}$ lbs. Each.....



No. 3914



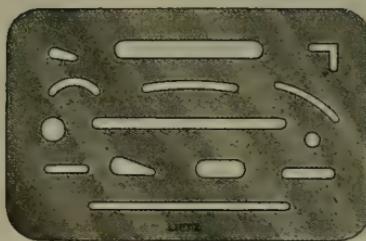
No. 3915

- No. 3914. (Old No. 3934.) Square, iron, leather-covered Paper Weight, $2\frac{1}{2} \times 2 \times 1\frac{1}{2}$ inches, $1\frac{1}{2}$ lbs. Each
No. 3915. (Old No. 3935.) Round, iron, green cloth-covered Paper Weight, $2\frac{1}{2}$ inches diameter, 1 lb.

See price list in back of catalog.

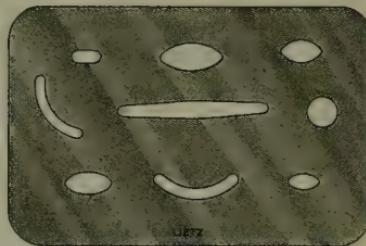
THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

ERASING SHIELDS



No. 3922

Size $2\frac{3}{8} \times 3\frac{3}{4}$ inches.



No. 3926

Doz. Each

No. 3922. German Silver Erasing Shield, 14 holes.....

No. 3924. Razor Steel Erasing Shield, 14 holes.....

No. 3926. Razor Steel Erasing Shield, 9 holes.....



No. 3927

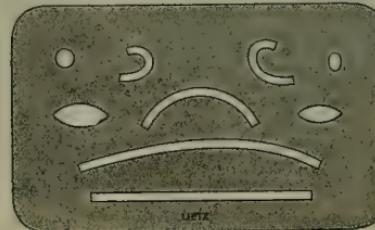
Size $1\frac{1}{8} \times 4\frac{1}{2}$ inches.

Doz. Each

No. 3927. Adjustable metal Erasing Shield.....

By means of a movable arm, any desired aperture may be obtained.

CELLULOID ERASING SHIELDS



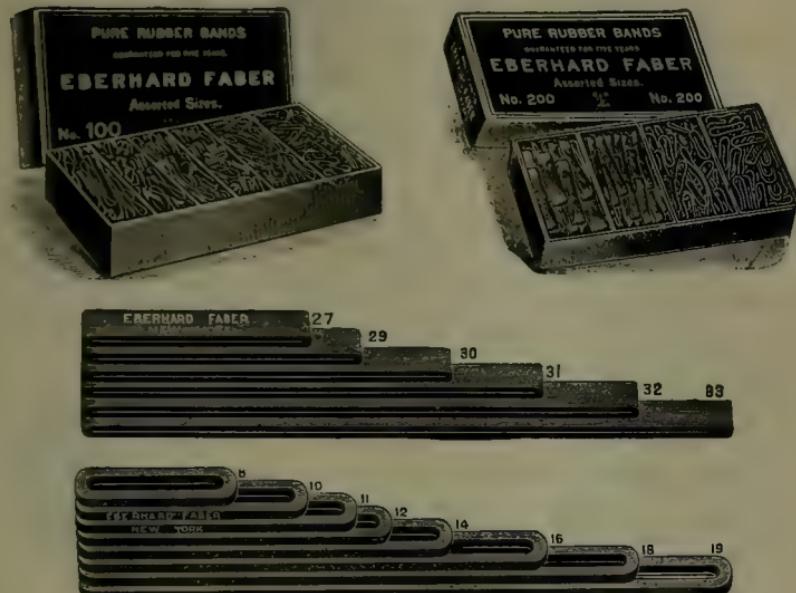
No. 3929

Doz. Each.

No. 3929. Transparent Celluloid Erasing Shield, 3x5 inches..

See price list in back of catalog.

GRAY RUBBER BANDS



- No. 3932. Assortment No. 100, containing Nos. 10, 12, 30, 32, 62, 64,
72, 84, 50
No. 3933. Assortment No. 200, containing Nos. 72, 62, 64, 84, 32, 50,
10, 12, 30
No. 3934. Assortment No. 300, containing Nos. 64, 62, 72, 84, 30, 50,
32, 10, 12
No. 3935. Assortment No. 400, containing Nos. 64, 72, 30, 32, 50, 10, 12

RUBBER BANDS IN BULK

Per pound

- No. 3936. Gray Rubber Bands in bulk, assorted or of one size.....



EYESHADES

Each

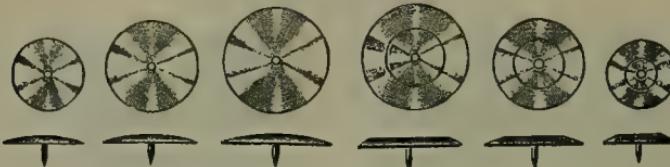
- No. 3938A. "Featherweight" Eyeshade, of
transparent green celluloid
No. 3938B. "Featherweight" Eyeshade, of
opaque celluloid

"Featherweight" Eyeshades are made from a single
piece of celluloid, adjustable to fit anyone. The lightest
eyeshade made.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

THUMB TACKS



Nos. 3940-42

Nos. 3944-46

GERMAN SILVER—BEST QUALITY

The pins are of hardened steel, screwed in and riveted.

Flat Heads

	Dozen
No. 3940. German silver Thumb Tacks, flat heads, $\frac{3}{8}$ inch diameter, carded
No. 3941. German silver Thumb Tacks, flat heads, $\frac{1}{2}$ inch diameter, carded
No. 3942. German silver Thumb Tacks, flat heads, $\frac{5}{8}$ inch diameter, carded

Beveled Heads

	Dozen
No. 3944. German silver Thumb Tacks, beveled heads, $\frac{3}{8}$ inch diameter, carded
No. 3945. German silver Thumb Tacks, beveled heads, $\frac{1}{2}$ inch diameter, carded
No. 3946. German silver Thumb Tacks, beveled heads, $\frac{5}{8}$ inch diameter, carded

BRASS—HIGHLY FINISHED

Riveted Pins—One Dozen on a Card



No. 3960

No. 3961

No. 3962

Flat Heads

	Gross Doz.
No. 3960. Brass Thumb Tacks, flat heads, $\frac{3}{8}$ inch diameter
No. 3961. Brass Thumb Tacks, flat heads, $\frac{1}{2}$ inch diameter
No. 3962. Brass Thumb Tacks, flat heads, $\frac{5}{8}$ inch diameter

TWISTOUT THUMB TACKS



Twistout has a small pin, screwed and riveted, leaves a small hole in drawing board and will not bend or break.

Twistout has a flat head with thin edge, thus a scale or straightedge will slip over without interference or injury.

Twistout has a slotted head which affords easy grip of the fingernails. Tack may be removed with ease by a slight twist with the fingers.

Twistout is a Quality Product.

No tack-lifter or puller required.

Per Gross Dozen

No. 3966. Twistout Thumbtacks, $9/16$ " dia., packed 1 doz. in box.....

See price list in back of catalog.

THUMB TACKS



Nos. 3970-3973

Stamped Steel

These Tacks are stamped out of one piece of hard steel and are of the best quality, and have needle-finished points.

LOOSE, IN BOXES

Box of 100

No. 3970.	Steel Stamped Thumb Tacks, 5/16 in. diameter.....	
No. 3971.	Steel Stamped Thumb Tacks, 3/8 in. diameter.....	
No. 3972.	Steel Stamped Thumb Tacks, 7/16 in. diameter.....	
No. 3972½.	Steel Stamped Thumb Tacks, 1/2 in. diameter.....	
No. 3973.	Steel Stamped Thumb Tacks, 9/16 in. diameter.....	

FOR SCHOOL USE

Per box

No. 3974.	Steel Stamped Thumb Tacks, 3/8 in. diameter, 1 dozen in tin box	
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SOLID STEEL



No. 3974



Very strong and durable. Pins will not pull out or push through.

Box of 100

No. 3976.	Solid Steel Thumb Tacks, 3/8 in. diameter.....	
No. 3977.	Solid Steel Thumb Tacks, 1/2 in. diameter.....	
No. 3978.	Solid Steel Thumb Tacks, 9/16 in. diameter.....	

TACK LIFTERS



No. 3980

No. 3981

Each

No. 3980.	Tack Lifter, bronzed brass	
No. 3981.	Improved Tack Lifter and Paper Cutter, nickel plated	

Tack Lifter No. 3981, owing to its beveled V-shape claw, catches the tack on the outside points of its circle, and by simply pushing the lifter forward, the tack is lifted without bending the pin.

For Combination Steel Lead Pencil File and Tack Lifter see Catalog No. 3844 page 455.

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

BRASS PAPER FASTENERS

Nos. 1



2



3



4



5



6



No. 4008



No. 4009

No. 4008. Paper Fasteners, round heads.

Number—	1	2	3	4	5	6
Length, inches—	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$
Per box of 100						
Per box of 1000						

No. 4009. Brass Washers for paper fasteners. Per 1000.....

GEM PAPER CLIPS



No. 4012 Exact size

Per box Per 1000

No. 4012. Gem Paper Clips, 100 in box.....

PAPER CLIPS



Nos. 4014A-C

Doz. Each

No. 4014A. Paper Clips, $1\frac{1}{4}$ in. long.....

No. 4014B. Paper Clips, $2\frac{1}{4}$ in. long.....

No. 4014C. Paper Clips, 3 in. long.....

See price list in back of catalog.

THE TRIUMPH EYELET PUNCH AND FASTENER



No. 4017

No. 4017.	Triumph Eyelet Punch and Fastener	Each
No. 4017A.	Eyelets for Triumph Punch and Fastener -	Box of 250
	Short	
	Medium long	
	Long	

The Triumph Eyelet Punch and Fastener is made of metal, nickel plated and is superior to any other of its kind. The "gauge," which enables papers to be punched at uniform distances, is a new feature of great utility and all the obnoxious breakage of springs, etc., which continually occurs in other eyelet punches, is impossible in the Triumph.



No. 4019

THE HOTCHKISS STAPLE PRESS

Holds 25 Staples.

Fed automatically.

Will fasten 2 to 25 sheets of paper.

No. 4019.	Hotchkiss Staple Press	Each
No. 4019A.	Staples for Hotchkiss Staple Press, packed 500 in a box. Per 1000	

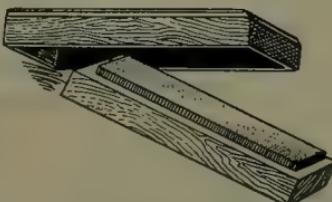
No. 4019A

OIL STONES

For sharpening Drawing Tools.



No. 4042



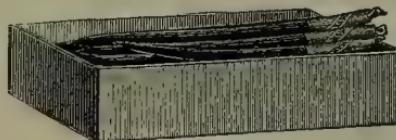
Nos. 4044-46

No. 4042.	Arkansas Oil Stone, wedge shape, about 1 1/4x3 in. Each.....
No. 4044.	Arkansas Oil Stone, in case with cover, 3 1/2x1 in. Each.....
No. 4046.	Arkansas Oil Stone, in case with cover, 5x2 in. Each.....

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SAN FRANCISCO, U. S. A. SURVEYORS' INSTRUMENTS

CHARCOAL



Per Box

No. 4050. Ordinary French Charcoal, 50 sticks in a box, 6 in. long....



No. 4063

Doz. Each

No. 4063. Brass Holders for charcoal or crayons, 5 in.....

STOMPS FOR CRAYON SHADING



No. 2

No. 4

No. 6

No. 4066

No. 4066. French Gray Paper Stomps for Crayon Shading. 2 4 6 8
No.— Doz.

TORTILLON STOMPS



No. 4068

Dozen

No. 4068. Tortillon Stomps, gray or white, thin paper, 3 in. long....

CHAMOIS SKINS

Each

No. 4072. Chamois Skins, best quality, $5\frac{1}{2} \times 8\frac{1}{2}$ inches.....

ATOMIZER AND FIXATIF



No. 4078

No. 4075

Each

No. 4075. Atomizer, japanned tin, folding.....

No. 4078. "Alco" Fixatif for pastel and charcoal drawings.
In bottles, $2\frac{1}{2}$ oz.

Each

Dozen

See price list in back of catalog.



WATER COLORS

WINSOR & NEWTON'S WATER COLORS

In whole and half Pans and Tubes.

	Class 1	
Charcoal Grey	Flake White	Olive Green
*Chinese White	Hooker's Green No.	Payne's Grey
Chrome Lemon	Hooker's Green No. 2	Permanent Blue
Chrome Yellow	Indian Red	Prussian Blue
Chrome Deep	Ivory Black	Raw Sienna
Chrome Orange	King's Yellow	Raw Umber
Cologne Earth	Lamp Black	Roman Ochre
Dragon's Blood	Light Red	Terre Verte
Emerald Green	Mauve	Vandyke Brown
Brown Pink	Gamboge	Venetian Red
Burnt Sienna	Indigo	Yellow Lake
Burnt Umber	Italian Pink	Yellow Ochre

*Chinese White in tubes and bottles, see page 472.

Doz. Each

- No. 4101. W. & N. Water Colors, Class 1, whole pan or tube
 No. 4101½. W. & N. Water Colors, Class 1, half pan

Class 2

Alizarin Crimson	Mars Yellow	Scarlet Lake
Alizarin Scarlet	Purple Lake	Sepia
Brown Madder	Roman Sepia	Warm Sepia
Carmine Lake	Sap Green	Vermilion
Crimson Lake		

Doz. Each

- No. 4102. W. & N. Water Colors, Class 2, whole pan or tube
 No. 4102½. W. & N. Water Colors, Class 2, half pan

Class 3

Cadmium Yellow, pale	Cobalt Violet	Oxide of Chromium
Cadmium Yellow	French Blue	Permanent Mauve
Cadmium Orange	Indian Yellow	Pure Scarlet
Cerulean Blue	Lemon Yellow	Scarlet Vermilion
Cobalt Blue	Mars Orange	Viridian
Cobalt Green	Orange Vermilion	

Doz. Each

- No. 4103. W. & N. Water Colors, Class 3, whole pan or tube
 No. 4103½. W. & N. Water Colors, Class 3, half pan

Class 4

Aureolin	Cobalt Yellow	Pink Madder
Aurora Yellow	Gallstone	Purple Madder
Burnt Carmine	Madder Carmine	Rose Madder
Carmine	Madder Lake	Scarlet Madder

Doz. Each

- No. 4104. W. & N. Water Colors, Class 4, whole pan or tube
 No. 4104½. W. & N. Water Colors, Class 4, half pan

Class 5

Smalt	Ultramarine Ash	Doz. Each
No. 4105. W. & N. Water Colors, Class 5, whole pan or tube		
No. 4105½. W. & N. Water Colors, Class 5, half pan		

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THE A. LIETZ COMPANY MODERN ENGINEERS' AND
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SAN FRANCISCO, U. S. A.

WINSOR & NEWTON'S CHINESE WHITE
In Tubes or Bottles



Nos. 4110-11



No. 4113

Doz. Each

- No. 4110.** W. & N. Chinese White, small tube, $\frac{1}{2} \times 2$ inches..
No. 4111. W. & N. Chinese White, large tube, $\frac{3}{4} \times 2$ inches....
No. 4113. W. & N. Chinese White, small bottle

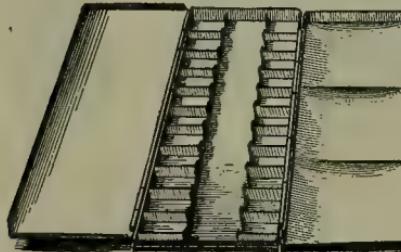
WATER COLOR STAMPS IN BOOKS

Each

- No. 4120.** Book containing 15 Water Color Stamps $6\frac{1}{2} \times 2\frac{3}{4}$ inches....

EMPTY JAPANNED TIN BOXES

For Winsor & Newton Water Colors



- No. 4140.** Japanned Tin Boxes for half pans, with space for brushes.

	Each	Each
12 Divisions		24 Division
16 Divisions		32 Divisions
20 Divisions		36 Divisions

- No. 4141.** Japanned Tin Boxes for whole pans, with space for brushes.

	Each	Each
6 Divisions		12 Divisions
8 Divisions		16 Divisions
10 Divisions		18 Divisions
		24 Divisions

See price list in back of catalog.

BOURGEOIS' FRENCH WATER COLORS



Nos. 4151-4155



No. 4160

The Bourgeois French Water Colors are put up in glass jars. They are moist and a slight rubbing of the desired colors with a moistened brush is sufficient to obtain the full richness of their tint. The colors are very brilliant in tone.

Series I

Burnt Sienna	Indian Red	Raw Umber
Burnt Umber	Light Red	Vandyke Brown
Dragon's Blood	Raw Sienna	Yellow Ochre

No. 4151. Bourgeois French Water Colors in jars. Each

Series II

Brilliant Yellow	Gamboge	Naples Yellow
Chinese White	Ivory Black	Neutral Tint
Crimson Lake	Italian Pink	Paynes Grey
Emerald Green	Lamp Black	

No. 4152. Bourgeois French Water Colors in jars. Each.....

Series III

Carmine	Chrome Deep	Prussian Blue
Chrome Yellow, Lemon	Crimson Lake, Dark	Ultramarine Blue, Deep
Chrome Yellow, Light	Golden Yellow	

No. 4153. Bourgeois French Water Colors in jars. Each.....

Series IV

Cadmium, Lemon	Cerulean Blue	Rose Madder
Cadmium, Medium	Cobalt Blue	
Cadmium, Deep	Madder Lake, Deep	

No. 4154. Bourgeois French Water Colors in jars. Each.....

Series V

Indian Yellow	Vermilion, Light	Vermilion, Deep
No. 4155.	Bourgeois French Water Colors in jars. Each.....	

No. 4155. Bourgeois French Water Colors in jars. Each.....

BOXES FOR BOURGEOIS' WATER COLORS

No. 4160. Polished Mahogany Boxes for Glass Jars.

18 Divisions, with space for brushes. Each.....

24 Divisions, with space for brushes. Each.....

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
SURVEYORS' INSTRUMENTS
SAN FRANCISCO, U. S. A.

**MOIST WATER COLORS IN JAPANNED TIN
BOXES**

THE "REMBRANDT"



No. 4166

No. 4166. "Rembrandt" Box, with 12 moist water colors and brushes Each

THE "MURILLO"



No. 4169

No. 4169. "Murillo" Box, $3\frac{1}{2} \times 7\frac{1}{2}$ inches, with 16 moist water colors in pans, and tubes of sepia and Chinese white, with brushes Each

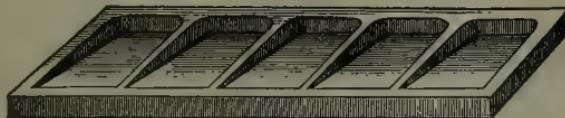
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**MOIST WATER COLORS IN JAPANNED TIN
BOXES**

No. 4174

No. 4174. Students' Box, with palette flap, containing 12 tubes of best quality moist water colors and one fine camel hair brush...

Each

ARTISTS' CHINAWARE

No. 4177

No. 4176. China Color Slants, 4 slopes, 3 x 8 inches.....
No. 4177. China Color Slants, 5 slopes, 3½x8 inches.....
No. 4178. China Color Slants, 6 slopes, 3½x8 inches.....
No. 4179. China Color Slants, 8 slopes, 6½x7¾ inches.....

Each



No. 4184

No. 4184. China Center Color Slant, 5 divisions, 2¾x6 inches.....

Each

See price list in back of catalog.

THE A. LIETZ COMPANY MODERN ENGINEERS' AND
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ARTISTS' CHINWARE



No. 4190



No. 4195

Each

- No. 4190. China Color Slants, 3 wells and 1 slope, $1\frac{1}{2} \times 2\frac{3}{4}$ inches....
No. 4191. China Color Slants, 3 wells and 1 slope, $2\frac{3}{4} \times 4\frac{1}{2}$ inches....
No. 4194. China Color Slants, 3 wells and 3 slopes, $2\frac{3}{4} \times 4$ inches....
No. 4195. China Color Slants, 5 wells and 5 slopes, $4\frac{1}{4} \times 7\frac{3}{4}$ inches....

CABINET NEST SAUCERS



Nos. 4200-4203

Per set

- No. 4200. China Cabinet Nest Saucers, 6 in set, $2\frac{3}{8}$ inches diameter..
No. 4201. China Cabinet Nest Saucers, 6 in set, $2\frac{3}{4}$ inches diameter..
No. 4202. China Cabinet Nest Saucers, 6 in set, $3\frac{3}{4}$ inches diameter..
No. 4203. China Cabinet Nest Saucers, 6 in set, $3\frac{3}{4}$ inches diameter..

WATER GLASSES



Nos. 4206-4208



No. 4209

Each

- No. 4206. Water Glass with two lips, $2\frac{1}{2}$ inches diameter.....
No. 4208. Water Glass with two lips, $3\frac{1}{2}$ inches diameter.....
No. 4209. Water Cups, enameled tin, 3 inches diameter.....

See price list in back of catalog.

BRUSHES FOR WATER COLOR PAINTING

We offer a select assortment of Quality Brushes. They are guaranteed to contain the proper amount of hairs, and to be made of genuine sable or camel hair.

SABLE BRUSHES**In Albata, with Handle**

Illustrations full size.



No. 4212. "Alco" Red Sable Brushes, in nickel-plated ferrules, black polished handles.

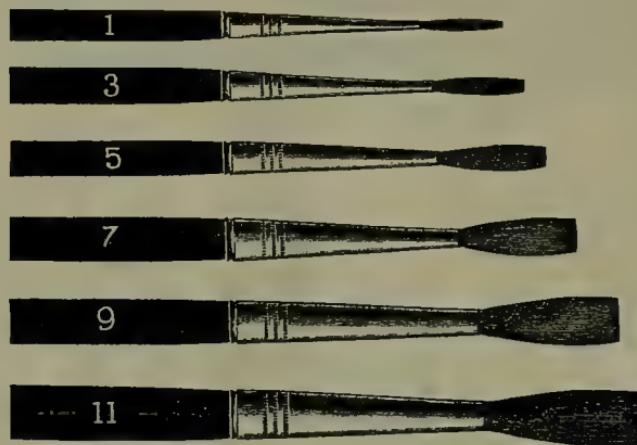
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Each

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THE A. LIETZ COMPANY MODERN ENGINEERS' AND
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ALCO RED SABLE SHOWCARD BRUSHES

Illustrations Full Size



Superfine quality of Red Sable Brushes in nickel-plated ferrules, polished handles; round ferrules, square ends.

These brushes are especially designed for one-stroke showcard lettering; will hold their shape well.

No. 4213. Alco Red Sable Showcard Brushes, finest red sable hair; nickel-plated ferrules, square ends.

No.— 1 3 5 7 9 11 12
Each



No. 4216C

CAMEL HAIR BRUSHES

Carded Assortments

No. 4216C. Camel Hair Brushes in tin ferrules, black polished handles; assortment of 4 each. Sizes 1, 2, 3, 4, 5, 6 (Card of 2 dozen). Per card.....

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CAMEL HAIR BRUSHES**For Water Color Painting**

Illustrations full size.



- No. 4215.** Extra fine Camel Hair Brushes in nickel-plated ferrules.
Black polished handles.

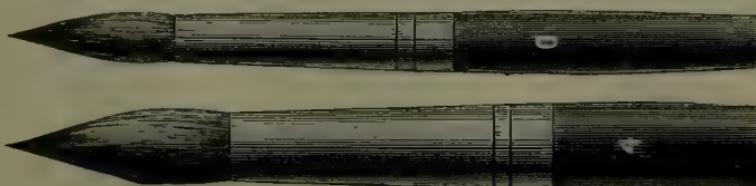
No.	1	2	3	4	5	6
Each						

- No. 4216.** Camel Hair Brushes in tin ferrules. Black polished handles.

No.	1	2	3	4	5	6
Each						

Dozen						
-------------	--	--	--	--	--	--

For Carded Assortment see page 478.



- No. 4217.** Superfine Camel Hair Brushes in tin ferrules, **Round** for
skies, washing, etc. Polished handles.

No.	0	1	2	3	4	5	6
Each							

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THE A. LIETZ COMPANY MODERN ENGINEERS' AND SURVEYORS' INSTRUMENTS
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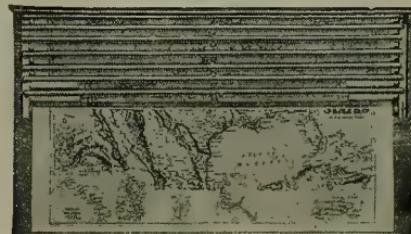
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SAN FRANCISCO, U. S. A.

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HELP

For the accommodation of the Engineering profession, employed or unemployed, we conduct a service or employment branch in conjunction with our Sales Department.

Parties seeking the services of Instrument Men, Level-men, Rodmen, Chainmen or Computors or Draftsmen are therefore invited to consult us.

We make no charge for this service, seeking only to establish a spirit of good will among the benefited, and therefore invite the unemployed to register with us.

We cheerfully arrange meetings, and while we cannot assume entire responsibility in the recommendations we may make, we give the assurance that our best judgment will prevail in our selections and decisions.

Let us be of service to you.

THE A. LIETZ CO.,
Sales Department.



SEP 10 1926

PRICE LIST

Applying to our

GENERAL CATALOG FIFTEENTH EDITION

Revised to

MAY 15, 1926

This Price List is published in the interest of our patrons to serve as a guide to present-day prices.

PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE.

Our sincere assurance is given that all orders will be invoiced at the lowest prices prevailing at time of purchase.



THE A. LIETZ COMPANY

Established 1882

Main Office and Factory

SAN FRANCISCO

LOS ANGELES

Store: 61 Post Street

1001 South Hill Street

OAKLAND

336 Twelfth Street

SOLAR ATTACHMENTS

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16	CUMBROUS	\$ 90.00
16S	CURATOR	\$162.50
	Page 92	
16B	CUTICLE	\$ 78.00
17D	CUSTARD	9.00
	Page 93	
17	CUNEATED	\$ 60.00
	Page 95	
19	BUMBOAT	\$225.00
	Page 97	
19G	BUMBRAY	\$350.00
	Page 99	
20	BUMPER	\$195.00
20T	BURGESS	210.00
	Page 101	
20G	BURGUNDY	Price on application
	Page 102	
21	BURROW	\$135.00
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21C	BURSAR	\$150.00
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PARTS OF TRANSIT SUSCEPTIBLE TO LOSS

(Prices on Application)

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PARTS OF LEVELS SUSCEPTIBLE TO LOSS

(Prices on Application)

LEVEL VIALS

Level vials for telescopes of Transits and Levels, per inch of length.....	\$1.50
Level vials for Plate and Standard of Transits (unmounted)	2.25
Circular Level vial (as furnished with our Hydrographic Y Level and Alidade)	6.00
Plain Level vials, not graduated, 1 to 4 inches long .....	.60
Plain Level vials, not graduated, 4½ to 6 inches long	1.25

COMPLETE LIST OF FEATURES APPLICABLE TO LIETZ LEVELS

Code Word

CUPID	Mirror to control bubble from eye end.....	\$15.00
CUPOLA	Stadia hairs fixed, set 1:100.....	4.50
CULTURE	Reversion level to telescope.....	18.00
CULVERIN	Constructed with 3 leveling screws instead of four.....	20.00
CURTAIN	Silk protection bag (waterproof).....	2.00
CUMBRANCE	Full extension tripod in lieu of straight leg.....	10.50
CUTEX	Bottle of fine instrument oil.....	.75
CUTWATER	Inverting eye-piece (made to order).....	No charge
CURLY	One extension leg in lieu of straight leg.....	3.50

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Tempered Steel Adjusting Pins for instrument adjustments.....	\$.10
Tempered Steel Adjusting Pins, large size for Y levels.....	.10
Phosphor Bronze Adjusting Pins for setting off variation.....	.10
Screwdriver for instrument box.....	.35
Camel Hair Dust Brush for instruments.....	.75

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32	CORDWAIN	\$200.00
32LC	CORDWEIGHT	212.00
	CUMBERSOME	14.25
	CULPABLE	7.50
	DIAGNOSE	25.00
	DROUGHT	15.00
	DIALECT	No charge
	DIALOGUE	17.50
	DIAMOND	25.00
	CUTWATER	No charge

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33	CORIANDER	\$215.00
	DIAGNOSE	25.00
	DIALECT	No charge
	DIALOGUE	17.50
	DIAMOND	25.00
	CUTWATER	No charge

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34 1/2 CE	DENTARY	\$ 42.50
34 1/2 CEC	DERBY	10.00
34 1/2 CEH	DERMIC	3.00
34FF	DRAGON	6.35
34H	DRAWN	5.25
34JJ	DRIBLET	7.00
34K	DRIFTAGE	7.00

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35 1/2	CORMORANT	\$ 16.00
36A	CORONAL	22.50
36C	CORRIDOR	10.00
34H	DRAWN	5.25
34K	DRIFTAGE	7.00
34A	DROUGHT	15.00
34MM	DRYING	1.00
34NN	DRYSALT	2.00

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38S	EAGLET	\$ 24.75
38L	EARING	24.75
39S	EARLDOM	35.25
39L	EARTHY	35.25
038S		5.60
038L		5.60
039S		7.20
039L		7.20
041CE		5.40
042A		1.95
042B		5.50
042C		1.90
042D		1.65
042E		.60
042F		.45
042G		.55
43		8.25
043A		2.25
043B		1.40
043C		.50
44A		18.50
44B		15.00

Page 122

46	EBONITE	\$ 80.00
46 1/2	EBURINE	55.00

Page 123

48	EBYING	\$100.00
58	ECHELON	16.50
59	ECHINATE	14.00

Page 124

65	EDGETOOL	On application
66	EDICTOR	On application

Page 125

70		Each \$ 1.00
70A		1.20
70B		1.45
71		1.50
74		1.10
75		1.25
76		2.00
77		2.50
78		3.00
79		3.00
80		3.00
79H		7.50
81		.70
83		4.50
84		.90

Page 126

85		Each \$ 1.50
86		1.65
87		1.80
88		2.20
89		2.65
90		3.45
91		4.50
95		1.50
96		3.00

Page 127

100		Each \$.60
101		.90
103		2.75
104		2.50
105		2.75
106		4.20
107		6.60
107A		8.50
108		14.50
108A		16.00

Page 128

109		Each \$ 4.90
110A		7.40
110B		8.75
112	EDUCATING	15.00
117	EDUCATION	5.00

Page 129

126A		Each \$ 4.00
126B		5.00
127A		4.50
127B		5.50
128		10.00
129A		2.70
129B		3.00
130		1.50

Page 130

132A		Each \$ 2.75
135		6.75
136		8.50
138		7.00

Page 131

140	EFFECTOR	\$ 25.00
141	EFFECTUAL	30.00
140LC	EFIICO	32.75
141LC	EFFIGY	39.50
144A		6.00
144C		5.25
144D		7.50
146	EFFERENT	2.95
147	EFFERO	6.95
148	EFFETE	11.50
149		6.00

Page 132

150		\$ 4.50
150A		4.50
154		35.00

Page 133

156		Each \$ 1.50
158		1.75
159		3.50
160		1.75
161		3.50
164		2.00
165		4.00
165G		8.50

Page 134

167A		Each \$ 6.75
167B		7.00
168		8.50
169		9.50
169A		11.00
170		6.75
175		40.00
175A		50.00

Page 135

183	EGLANTO	\$ 30.00
183A	EGLOMBO	30.00
184	EGOTIC	37.50
185A	ELAND	3.00
185B	ELAPSE	3.75
185C	ELASTIC	7.20
185D	ELATE	6.00
185E		.25
185F		1.35
185G		.60
185H		.35
185I		1.90
185J		2.25
185K		3.75

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186	ELECTOR	\$ 22.50
187	ELECTIVE	30.00
189	ELECTRON	8.00
190	ELEGANT	7.25
191		1.50
192	ELEVATOR	5.50
193		1.25

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195	ELFFIRE	\$ 19.50
195A	ELFLOCK	19.50
196		3.00
198	ELKBORN	28.00
198A	ELKHEAD	28.00
198B	ELKFORK	28.00
199	ELKTON	9.00
199A	ELKWOOD	17.50
197A		.25
197B		.25
197C		2.00
197D		1.25
197E		.25

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Book — Geo. W. Plympton — Ba-	
rometer, etc.	\$.50

Book — P. R. Jameson — Barometer,
etc. .15

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200	EPACT	\$ 35.50
200C	EPAULET	32.50
200D	EPHOD	36.00
200E	EPICURE	35.00
202C	EPIDILE	25.00
202E	EPIGRAM	27.00

Page 140

205	EPILOGUE	\$ 45.00
205A	EPIMORE	44.00
205C	EPISODE	42.00
205D	EPISTERM	45.00
105E	EPITAPH	44.00
205F	EPITHET	47.50
206		4.50
206A		\$ 5.50
206B		2.50
206D		2.25
207	EPITOME	2.00

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205 1/2 D	EQUATOR	\$ 37.00
208D	EQUERRY	36.50

Page 142

208	ERBIUM	\$ 122.50
208B	ERECTOR	117.00
208D	EREMITE	122.00
208F	ERGMETER	128.00
208AL	ERGOT	132.50
208ALB	ERMIN	127.00
208ALD	EROTIC	132.00
208ALF	ERUDITE	138.00
210	ESCALADE	102.00
210A	ESCARP	109.00
211	EXCELSIOR	107.50
211B	EXCHEQUER	102.00
211D	EXCLAVE	107.00
211F	EXCRETA	113.00
211AL	EXCURSION	116.00
211ALB	EXEMPLAR	109.00
211ALD	EXOGEN	114.00
211ALF	EXPLORER	120.00

	Page 143	Each		Page 150	Each
220		\$ 9.50	284		\$ 2.00
221		10.50	285		2.25
222		15.00	288		2.00
223		20.00	289		2.50
224		22.75	294		.70
225		32.50			
223G		27.00			
226		25.00			
227		27.00			
228		Discontinued			
230					
	Page 144	Each		Page 151	Each
235A		\$ 82.50	300A		\$ 1.60
235B		78.00	300B		1.60
235C		78.00	300C		1.70
236		3.50	300D		1.90
237		.60	300E		2.50
238		6.00	301A		1.60
240 FABEL		125.00	301B		1.70
	Page 145	Each	301C		1.90
242 FABLING		\$ 60.00	301D		2.50
244 FABLUS		80.00	305A		6.00
	Page 146	Each	305B		6.00
248 FACULTY		\$ 155.00	305C		8.00
249 FADING		90.00	305D		7.00
	Extra Charts		305E		8.00
2 Per Set.		3.00	305F		10.00
6 Per Set.		3.00	305G		13.00
84 Per Set.		\$ 3.00	306A		6.00
85 Per Set.		3.00	306B		6.00
20 Per Set.		3.50	306C		7.00
249A Per Set.		3.50	306D		8.00
250A Each.		1.25	306E		10.00
250B Each.		1.50	306F		13.00
250C Each.		.60	0305A		3.00
250D Each.		1.00	0305B		3.00
250E Each.		7.50	0305C		3.00
	Page 147	Each	0305D		4.00
252 FAGGIN		\$ 5.50	0305E		5.00
252A		2.25	0305F		7.00
252B		.45	0305G		10.00
252D		.15	0306A		3.00
256 FAGLON		11.50	0306B		3.00
257 FAGUS		15.50	0306C		4.00
256A		5.00	0306D		5.00
257A		5.00	0306E		7.00
	Page 148	Each	0306F		10.00
265 FALCON		\$ 12.00	Page 152	Each	
266 FALCONER		6.00	310		\$ 8.00
267 FALCONRY		6.00	311		10.00
	Page 149	Each	312		4.00
278		\$ 6.25	0310		5.00
279		6.75	0311		7.00
278C		6.75	0312		3.75
279C		7.25	315		3.00
280		2.50	316		3.00
282		7.00	0315		2.75
283		2.75	0316		2.75
282 1/2		2.50	Page 153	Each	
283 1/2		2.75	320 FANION		\$ 11.00

Page 154

332	Each	\$ 54.00
332A		54.00
334		50.00
334A		45.00
334B		75.00
335		4.50
335A		7.00
338		75.00

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345	Page 156	Each
Rating Table	FIREBALL	\$ 100.00
Rating Table	FIRKIN	17.50
347	FISHMAW	110.00
Rating Table	FIRKIN	17.50

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348	Page 157	Each
Rating Table	FISSURE	\$ 90.00
Rating Table	FIRKIN	17.50
346A		.10
346B		6.00
346C		\$ 7.50
346D	FIRSTLING	20.00
346E		.75
346F		.50
346G		.40
346H		1.90
346I		1.50
346J		5.50
346K		5.00
346KK		.40
346M		.50
346N		.50

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349	Page 158	Per C
349A		\$ 4.00
350	FIXITY	Each
351	FLAGMAN	3.50
351A	FLAMBAGE	54.00
353	FLAMINGO	22.50
355	FLIRTON	19.50
		25.00
		40.00

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360	Page 160	Each
360A	FLANKER	\$ 65.00
360B	FLASHING	75.00
360C	FLEXOR	75.00
360C	FLINCH	75.00
362	Page 161	Each

362	FLINDER	\$ 95.00
362A	FLIPPER	105.00
362B	FLOCKER	105.00
362C	FLOORER	105.00
365A		Per C
365C		5.00
365C		5.00
365E		Each
365F		.320
365G		.10
365H		.60
365J		.35
365K		.60
365K		1.75

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367	Page 162	Each
367	FLORAN	\$ 325.00
368	FLORATO	1.25

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PRICE LIST HENSOLDT PRISM BINOCULARS

Model	Magnification	Dia. of Objective	Each
375—Theater-Dialyt 3½X	3½ times	16 Millimeters	\$ 46.00
Universal-Dialyt 6X	6 times	26 Millimeters	60.00
Jagd-Dialyt 6X	6 times	36 Millimeters	76.00
Marine-Dialyt 8X	8 times	50 Millimeters	100.00
Mountain-Dialyt 10X	10 times	50 Millimeters	100.00
Mountain-Dialyt 16X	16 times	50 Millimeters	110.00
Mountain-Dialyt 18X	18 times	50 Millimeters	120.00

376—Monoculars half price of Binoculars.

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Model	Magnification	Dia. of Objective	Each
380—Telsex 6X	6 times	24 Millimeters	\$ 50.00
Telacht 8X	8 times	24 Millimeters	55.00
Teljagd	6 times	30 Millimeters	65.00
Telachtar	8 times	30 Millimeters	70.00
Telzwoelf	12 times	30 Millimeters	76.00

Note: 25 Millimeters are equal to one inch.

Page 166

390		Each	\$ 15.00
392			18.75
393			20.00
394			24.50

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400	FLORIST	Each	\$ 6.00
401	FLORY		6.00
402	FLOSSH		6.00
403	FLOUNDER		1.65
406A	FLOURY		2.20
406B	FLOWBIT		2.75
408	FLOWERET		1.65

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410	FLUFF	Each	\$ 25.00
411	FLUID		21.50
412	FLUKE		18.50
413	FLUNK		18.50
414	FLUSH		18.00
415	FLURRY		16.50
421	FLUTIST		20.50
422	FLUWAL		18.50
423	FLUX		18.50
425	FLUXION		16.50
428	FLYBLOW		19.50
430	FLYKITE		11.50
431	FLYWHEEL		11.50
437			6.00
438			10.00
438	in lieu of ordinary		4.00
439			3.00
440			.50
441	FOAM		3.50
442	FOCAL		4.00
446	FOEMAN		21.50
447	FOGBANK		19.50
449	FOGBELL		5.00

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450	FOILER	Each	\$ 17.50
451	FOISTER		21.00
454	FOLDEROL		17.50
455	FOLIOLE		21.00
460	FOLLICLE		13.50
461	FOLLOWER		15.50
462	FOLLY		17.50
465A	FOMER		3.75
465B	FONDU		4.65
465C	FONTAL		5.25
466A	FOOTBALL		4.00
466B	FOOTMAN		4.60
466C	FOOTPAD		5.65
467A	FORAGE		4.40
467B	FORAMEN		5.20
467C	FORAY		6.10
468	FOREBOW		6.60
469	FORECEST		5.50

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470A	FORELAND	Each	\$ 16.50
470B	FORELOCK		22.00
471A	FORERUN		16.50
471B	FORESAIL		22.00
472A	FORESTAY		3.25
472B	FORETOP		3.25
472-2S	FOREWIND (pair)		7.50

Page 173

474		Each	\$ 1.35
475			1.75
476			2.15
477			2.60
478			3.35
479			3.75
480			4.40
481			5.30
482			6.50
484A			.40
484C			.60
485A	(per yard)		.04
485B	(per yard)		.04
485C	(per yard)		.04
486	(per yard)		.06

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490		Each	\$.75
515			.60
516A			.75
516B			.90
516C			1.10
516D			1.75
520			.90

Page 175

521		Each	\$ 3.30
521A			5.00
522			2.75
522A			4.25
523			3.90
523 1/2			3.00
524			3.00
525			2.00
526			2.50
526A			3.25
528B			.15
528C			.40
531A			1.00
531B	(1000)	Per Set	18.00
532A			1.00
532B	(1000)	Per Set	18.00

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534		Per Set	\$ 2.25
535			2.60
536			1.40
537			1.50
539			2.10
545		Each	.35
547			2.00
548			3.75
549			3.20
550	(per yard)		.30
551	(per yard)		.20

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5100		Each	\$ 10.50
5150			14.00
5200			16.50
5300			25.00
5066			9.10
5132			14.00
5082M			10.20
5100M			11.60

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	Each
5164M	\$17.50
5328M	31.50
05100	7.00
05150	9.80
05200	12.25
05300	18.70
05066	5.60
05132	9.80
05082M	6.70
05100M	8.10
05164M	13.30
05328M	24.50
Thongs only	.75
05050S	10.00
5050S	14.00
5100S	16.40
05100S	12.90
05100SC	16.00

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	Each
4100	\$ 17.50
4150	20.30
4200	22.80
4300	31.00
4500	44.00
4066	16.10
4132	20.30
4082M	17.20
4100M	18.60
4164M	23.80
4328M	36.80
04100	7.00
04150	9.80
04200	12.25
04300	18.70
04500	31.50
04066	5.60
04132	9.80
04082M	6.70
04100M	8.10
04164M	13.30
04328M	24.50
Thongs only	.75

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	Each
2100	\$ 10.50
2150	14.00
2200	16.50
2300	25.00
2500	38.50
2066	9.10
2132	14.00
3100	10.50
3066	9.10
02100	7.00
02150	9.80
02200	12.25
02300	18.70
02500	31.50
02066	5.60
02132	9.80
03100	7.00
03066	5.60
Shoulder for Chain Tapes, pair...	.85

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	Each
8100	\$ 9.90
8200	15.50
8300	22.75
8500	36.30
8066	8.50
8132	13.20
9050	8.25
9100	9.90
9200	15.50
9300	22.75
9066	8.50
9132	13.20
9020M	8.50
9040M	13.60
08100	6.60
08200	11.50
08300	17.50
08500	29.70
08066	5.30
08132	9.20
09050	4.95
09100	6.60
09200	11.50
09300	17.50
09066	5.30
09132	9.20
09020M	5.50
09040M	10.00

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	Each
Cripple Creek Reel	\$ 42.00
Staff for above	8.00
1914—100 ft.	16.30
1914—200-300 ft.	19.00
1914—500 ft.	21.50

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	Each
273 or 273D	\$ 8.35
275 " 275D	11.90
276 " 276D	14.20
584	.26
585	.25
586	.75

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	Per Pair
650	Per pair \$.90
654	Each .60
655	.60
625	4.25
626	4.35
627	5.25
628	6.25
629	9.00
635	1.40
636	6.75

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1273 or 1273D	\$ 8.35
1275 " 1275D	11.90
1275 " 1276D	14.20
1280 " 1280D	5.00
1281 " 1281D	5.60
1283 " 1283D	7.15
1284 " 1284D	8.20
1285 " 1285D	9.85
1286 " 1286D	12.25
1293 " 1293D	8.35
1296 " 1296D	14.20

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1270WB	\$ 7.50
1271WB	8.20
1273WB	9.85
1280WB	6.50
1281WB	7.10
1283WB	8.70
1280XWB	9.00
1281XWB	10.00
1283XWB	12.95
588	2.10
589	2.90
590	4.40

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1291S	\$ 13.20
1293S	15.10

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231 or 231D	\$ 7.50
233 " 233D	8.75
234 " 234D	11.30
235 " 235D	12.50
236 " 236D	15.60
1373 " 1373D	11.10
1376 " 1376D	19.00
1377 " 1377D	28.00

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200 or 200D	\$ 5.45
203 " 203D	8.60
205 " 205D	12.50
206 " 206D	15.00
100 " 100D	5.10
103 " 103D	7.70
105 " 105D	11.10
106 " 106D	13.40
103DOB	8.70

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260 or 260D	\$ 4.90
263 " 263D	6.00
265 " 265D	7.80
266 " 266D	10.20
263DOB	7.00
263MOB	7.00
266DOB	12.20
266MOB	12.20
1260 or 1260D	4.70
1263 " 1263D	5.70
1265 " 1265D	7.50
1266 " 1266D	9.60
1263DOB	6.70
1263MOB	6.70

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240 or 240D	\$. 4.45
243 " 243D	5.40
246 " 246D	7.20
1240 " 1240D	4.20
1243 " 1243D	5.15
1246 " 1246D	8.75
241P	6.75
243P	8.25
1243P	8.00
241XP	10.15
243XP	13.00

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550	\$. 4.20
553	5.25
556	8.75
143	.75
145	.95
146	1.00
148	1.50
143D	.80
145D	1.05
146D	1.25
148D	1.75
143EM	.80
145EM	1.05
146EM	1.25
148EM	1.75
391	1.25
392	1.25
393	1.25

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25 ft. (one side)	\$. 3.60
33 " "	3.90
50 " "	4.50
66 " "	5.65
75 " "	6.00
100 " "	7.80
25 ft. (both sides)	4.40
33 " "	4.80
50 " "	6.00
66 " "	7.60
75 " "	8.30
100 " "	10.80

Lines only $\frac{3}{8}$ in.	Each
25 ft. (one side)	\$. 3.40
50 " "	4.30
75 " "	5.70
100 " "	7.40
Lines only $\frac{1}{4}$ in. Light.	Each
25 ft. (one side)	\$. 3.40
50 " "	4.30
75 " "	5.70
100 " "	7.40
25 ft. (both sides)	4.20
50 " "	5.70
75 " "	7.90
100 " "	10.25
Lines only Heavy $\frac{1}{4}$ in.	Each
33 ft. (one side)	\$. 5.40
50 " "	6.80
66 " "	8.40
75 " "	10.20
100 " "	12.70
33 ft. (both sides)	6.30
50 " "	8.40
75 " "	10.70
100 " "	12.70

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Oil Gauge, $\frac{1}{2}$ in.

	Each	\$
33 ft.	5.75	
50 ft.	6.35	

Repairs

	Each	\$
A	.50	
B	.15	
C	.45	
D	.15	
E	.75	
F	.35	
G	.15	

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	Each	\$
675	5.50	
675A	1.60	
B	.60	
C	.50	
D	.50	
E	.25	
F	.10	
G	.35	
680	19.50	

Page 195

	Each	\$
685	.60	
685A	.25	
686	.70	
690	.50	

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	Each	\$
603 or 603D	5.25	
606 " 606D	7.80	
660 " 660D	3.25	
663 " 663D	4.10	
173	.65	
175	.75	
176	.85	

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	Each	\$
500 or 500D	3.10	
503 " 503D	4.50	
505 " 505D	5.60	
506 " 506D	7.00	
503DL or 503ME	4.70	
505 $\frac{1}{2}$ ME	6.50	
506DL or 506ME	7.60	
0660 or 0660D	1.35	
0663 " 0663D	2.25	
0500 " 0500D	1.45	
0503 " 0503D	2.50	
0505 " 0505D	3.25	
0506 " 0506D	4.70	
0503M	2.50	
0505 $\frac{1}{2}$ M	3.80	
0506M	4.70	
0500DL	1.65	
0503DL or 0503ME	2.70	
0505DL	3.60	
0505 $\frac{1}{2}$ ME	4.20	
0506DL or 0506ME	5.25	

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	Doz.	Each
760 Leather Bdg.	\$14.00	\$1.25
760F Fabrikoid "	10.50	.95
761 Leather ..	13.20	1.15
761F Fabrikoid ..	9.50	.85
762 Leather ..	13.20	1.15
763 "	14.00	1.25
763F Fabrikoid ..	10.50	.95
764 Leather ..	14.40	1.25
764F Fabrikoid ..	10.50	.95
766 Leather ..	14.40	1.25
768 "	20.40	1.75
770 "	12.60	1.10
772 "	13.80	1.20
772F Fabrikoid ..	9.75	.85
773 Leather ..	12.60	1.10
773F Fabrikoid ..	9.50	.85
774 Leather ..	16.80	1.45
774F Fabrikoid ..	13.20	1.15
775 Leather ..	30.00	3.00
777 "	14.40	1.25
778 "	16.50	1.40
778F Fabrikoid ..	13.00	1.20
779 Leather ..	20.40	1.75
779F Fabrikoid ..	15.50	1.35
	Per 100	
0760	\$1.25	
0760D	2.40	
0763	1.25	
0763D	2.40	
0764	1.25	
0764D	2.40	
0772	1.25	
0772D	2.40	
0777	1.25	
0777D	2.40	
798	.25	
	Each	
800	\$1.95	
802	4.50	
802M	5.00	
804	7.50	
805	10.50	
	Per 100	Doz.
807	\$4.80	.65
808	5.50	.75
	Each	
2260	\$.25	
2261	.25	
2262	.25	
2263	.25	
2264	.25	
2265	.25	
2255	1.50	
2256	.85	
3778	Doz. 1.50	
	Doz.	Each

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815		\$ 8.50
816		2.50
820		1.00
825-12		5.25
25		7.50
50		12.00
100		21.00
826-12		5.25
25		7.50
50		12.00
100		21.00

Page 208 Roll Yard

840G	\$ 9.00	\$.25
840O	9.00	.25
840½G	6.50	.15
840½O	6.50	.15
841G	23.50	1.35
841O	23.50	1.35
842O	7.50	.20
842½O	6.00	.15
843G	20.00	1.20
843O	20.00	1.20
844G	23.50	1.35
844O	23.50	1.35
844½O	20.00	1.10
846G	9.00	.25
846O	9.00	.25
847O	7.50	.20
848G	23.50	1.35
848O	23.50	1.35

Page 209 Roll Yard

850G	\$ 9.00	\$.25
850O	9.00	.25
850½G	6.50	.15
850½O	6.50	.15
851G	23.50	1.35
851O	23.50	1.35
852O	7.50	.20
852½O	6.00	.15
853G	20.00	1.20
853O	20.00	1.20
854G	23.50	1.35
854O	23.50	1.35
854½O	20.00	1.10
856G	9.00	.25
856O	9.00	.25
857O	7.50	.20
858G	23.50	1.35
858O	23.50	1.35

Page 210 Roll Yard

860G	\$ 9.00	\$.25
860O	9.00	.25
861G	23.50	1.35
861O	23.50	1.35
862O	7.50	.20
863G	20.00	1.20
863O	20.00	1.20
864G	23.50	1.35
864O	23.50	1.35
870O	9.00	.25
871O	23.50	1.35
872O	7.50	.20
874O	23.50	1.35
878O	7.50	.30

Page 211 Quire Sheet

880G	\$ 3.50	\$.20
880O	3.50	.20
881O	3.50	.20
882G	3.50	.20
882O	3.50	.20
883O	3.50	.20
884G	3.50	.20
885G	3.50	.20
885O	3.50	.20
886O	3.50	.20

Per 100 Quire

890A	\$ 1.25	\$.35
891O	1.10	.30
892A	1.75	.50
893O	1.50	.45
894A	3.50	1.00
895O	3.40	.95
900A	1.25	.35
901O	1.10	.30
902O	1.75	.50
903O	1.50	.45

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908	Per 100	Quire	Sheet
909	\$ 15.00	\$ 4.00	\$.20
910	13.50	3.50	.15
911	3.85	1.25	2/.15
912	3.85	1.25	2/.15
913	4.15	1.30	2/.15
914	4.15	1.30	2/.15
915	7.50	2.30	.10
916	3.35	1.00	.05
917	3.35	1.00	.05
919	3.35	1.00	.05
920	3.35	1.00	.05
921	3.35	1.00	.05

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923	Ream	Quire	Sheet
924	\$ 10.00	\$.50	3/.10
924	10.00	.50	3/.10

Per 100 Quire Sheet

924½	\$ 4.15	\$ 1.30	2/.15
925	\$ 8.00	\$.10	
926	8.00	.10	
927A	2.25	.05	
927B	2.25	.05	
927C	2.25	.05	
927D	2.25	.05	
928C	\$ 1.20		2/.15

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Per Pad

929A		\$.70
929B		1.20

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Per Pad

930		\$.80
-----	--	--------

Per 100

Doz.

Each

931	\$ 7.00	\$.75	\$.07
933	7.00	.75	.07
934	7.00	.75	.07
935	7.00	.75	.07
936	7.00	.75	.07
937	14.00	1.50	.15
938	14.00	1.50	.15
940	20.00	2.00	.20
941	20.00	2.00	.20
943	20.00	2.00	.20
945		13.50	1.25
945 1/4		13.50	1.25
945 1/2		13.50	1.25

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Ream

Quire

Sheet

950	\$30.00	\$1.80	\$.10
951	30.00	1.80	.10
952	30.00	1.80	.10
953	30.00	1.80	.10
954	30.00	1.80	.10
955	30.00	1.80	.10
956	30.00	1.80	.10

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Ream

Quire

Sheet

Select Best

1000			
Cap	\$ 20.90	\$ 1.15	\$.06
Demy	34.80	1.90	.10
Medium	49.10	2.70	.14
Royal	63.50	3.45	.17
Imperial	114.40	6.25	.31
Atlas	149.50	8.20	.41
Dbl. Ele.	205.75	11.30	.54
Antiq.	742.50	40.85	2.05

1001

Select Best

Imperial		Ream	Quire	Sheet
Dbl. Ele.		\$194.90	\$10.70	\$.54

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Ream

Quire

Sheet

1005—18x24	\$37.50	\$2.40	\$.15
22x30	54.60	3.50	.20
24x36	71.00	4.50	.25
27x40	87.70	5.60	.30
1006—9x12	7.30	.50	2/.05
12x18	14.00	.90	.05
18x24	26.20	1.65	.10
22x30	46.10	2.85	.15
24x36	49.80	3.10	.20
27x40	75.50	4.50	.25
1007—13 1/2 x 17	7.70	.40	.02
15x20	12.00	.70	.04
17x22	16.30	.90	.06
19x24	21.30	1.10	.06
22x30	29.80	1.90	.10
27x40	57.60	3.60	.20

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Ream

Quire

Sheet

1008—9x12	\$ 9.50	\$.60	\$.03
12x18	18.00	1.10	.05
18x24	35.30	2.10	.10
22x30	51.00	3.10	.15
24x36	69.50	4.00	.20
27x40	83.75	5.10	.25
1009—9x12	6.80	.45	.03
12x18	13.20	.85	.05
18x24	25.25	1.50	.08
22x30	36.50	2.20	.15
24x36	50.00	2.90	.15
27x40	60.00	3.50	.20
1010—9x12	4.50	.35	.02
12x18	8.50	.60	.03
18x24	16.50	1.10	.05
24x36	32.00	2.00	.10

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	Dozen	Each
1015	\$10.80	\$.90
1016	12.60	1.10
1017	4.50	.40
1018 Thick	6.75	.60
Double thick	11.50	1.00
1020 Class A	10.00	.90
Class B	8.50	.75
Class C	6.75	.60

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	Per 100	Each
1025 2 sheets	\$23.60	\$.25
3 sheets	35.40	.40
4 sheets	48.00	.55
5 sheets	60.00	.65

	Per Ream	Quire	Sheet
	Dozen	Each	
1028	\$24.00	\$1.40	\$.10
1043	\$ 3.00	\$.25	
1044	4.20	.35	
1045	1.50	.15	
1046	4.80	.40	
1047	7.00	.60	
1048	10.00	1.00	

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	Dozen	Each
1052	\$ 3.00	\$.25

1054—2 Sheets.

12 x15	2.20	.20
14 x18	3.20	.30
16½x21	4.55	.40
18 x22	5.55	.50
20½x28	10.10	.90

1054—3 Sheets.

12 x15	3.30	.30
14 x18	4.80	.45
16½x21	6.85	.65
18 x22	8.35	.80
20½x28	15.15	1.40

1054—4 Sheets.

12 x15	4.40	.40
14 x18	6.40	.60
16½x21	9.10	.80
18 x22	11.10	1.00
20½x28	20.20	1.80

	Gross	Doz.	Each
1055A	\$25.00	\$2.20	\$.20
B	37.60	3.30	.30
1056½A	9.00	.90	.10
1056½B	12.00	1.20	.13
1057A	20.00	1.75	.15
B	28.50	2.50	.25
1058½A	7.50	.70	.07
1058½B	10.50	1.00	.10

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	10 yds.	Per yd.
1060—36 in.	\$ 4.90	\$.60
42 in.	5.85	.70
63 in.	8.00	.95
Per lb.	.80	
1061—63 in.	9.90	1.20
72 in.	12.60	1.45
Per lb.	.80	
1064—36 in.	4.90	.60
42 in.	5.85	.70
63 in.	8.00	.95
Per lb.	.80	
1065—63 in.	9.90	1.20
Per lb.	.80	

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	10 yds.	Per yd.
1068—36 in.	\$ 3.60	\$.40
63 in.	6.20	.75
Per lb.	.80	
1069—63 in.	7.30	.90
Per lb.	.80	
1070—30 in.	\$10.25	\$ 2.25
36 in.	12.00	2.65
42 in.	14.00	3.10
60 in.	20.25	4.50
Per lb.	.47	
1071—36 in.	10.40	2.40
42 in.	11.60	2.55
Per lb.	.42	
1073—42 in.	11.70	2.60
		.30

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	50 yds.	10 yds.	Per yd.
1080—30 in.	\$ 8.35	\$ 1.90	\$.25
36 in.	9.90	2.25	.25
42 in.	11.20	2.60	.30
63 in.	17.00	4.00	.45
Per lb.	.43		
1081—30 in.	6.15	1.30	.16
36 in.	7.35	1.55	.18
42 in.	9.70	2.10	.25
Per lb.	.35		
1084—36 in.	9.90	2.25	.25
42 in.	11.20	2.60	.30
Per lb.	.43		

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	100 yds.	50 yds.	10 yds.	Per yd.
1086A—				
36 in.	\$ 6.90	\$ 3.80	\$.95	\$.12
42 in.	7.50	4.30	1.10	.13
Per lb.				.25
1086B—				
36 in.	9.00	4.90	1.10	.15
42 in.	10.00	5.70	1.45	.20
48 in.	12.25	6.75	1.70	.20
54 in.	15.00	8.35	2.10	.25
Per lb.				.25
1086C—				
36 in.	11.20	6.20	1.60	.20
42 in.	12.40	6.90	1.75	.21
48 in.	14.50	8.00	2.00	.25
54 in.	16.75	9.50	2.70	.32
Per lb.				.25

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	100 yds.	50 yds.	10 yds.	Per yd.
1087—				
36 in....	\$11.00	\$6.15	\$1.50	\$.19
42 in....	13.65	7.60	1.75	.22
48 in....	16.25	8.90	2.05	.26
		Per lb.		.25

1088—

36 in....	11.00	6.15	1.50	.19
42 in....	13.65	7.60	1.75	.22
48 in....	16.25	8.90	2.05	.26
		Per lb.		.25

1089—

36 in....	7.50	1.80	.25	
42 in....	8.90	2.25	.30	
		Per lb.		.35

1095—

36 in....	9.65	1.00	
42 in....	10.75	1.15	

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	Each
1096	\$1.25
1096A	.50
1098	.60
1099—12 in.	3.10
18 in....	3.50
24 in....	4.00
30 in....	4.20
36 in....	4.25
48 in....	5.00

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	Sheet
1000MS —19x24	\$.65
22x30	.95
27x40	1.70
1060MS —19x24	.70
22x30	1.00
27x40	1.75
1064MS —19x24	.70
22x30	1.00
27x40	1.75
1000DMS—19x24	1.30
22x30	1.90
27x40	3.40
1060DMS—22x30	2.00
27x40	3.50
1064DMS—22x30	2.00
27x40	3.50

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	10 yds.	Per yd.
1060M—36 in.	\$16.00	\$1.95
42 in....	19.50	2.35
63 in....	28.00	3.50
1061M—63 in.	31.00	3.90
72 in....	40.00	5.00
1064M—36 in.	16.00	1.85
42 in....	19.50	2.35
63 in....	28.00	3.50
1065M—63 in.	31.00	3.90
1068M—36 in.	14.00	1.70
63 in....	28.00	3.50
1069M—63 in.	30.00	3.70

Page 231

	10 yds.	Per yd.
1070M—30 in.	\$13.00	\$1.60
36 in....	13.50	1.65
42 in....	16.00	1.95
60 in....	26.50	3.20
1080M—30 in.	13.00	1.60
36 in....	13.50	1.65
42 in....	16.00	1.95
63 in....	26.50	3.30

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	24 yds.	Per yd.
1100—30 in.	\$23.50	\$1.20
36 in....	27.00	1.35
42 in....	32.00	1.60
1101—24 in.	20.70	1.10
30 in....	21.50	1.15
36 in....	24.75	1.25
38 in....	27.00	1.40
41 in....	29.50	1.60
48 in....	37.75	2.10
54 in....	46.75	2.60
1102—30 in.	18.75	1.00
36 in....	21.50	1.15
42 in....	26.50	1.40

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	Each
1106	\$.25
1107—1 pint	5.00
4 oz....	1.40
1 oz....	.45

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	20 yds.	Per yd.
1120—30 in.	\$ 4.00	\$.25
36 in....	4.60	.30
42 in....	5.00	.30
1121—36 in.	4.60	.30
42 in....	5.00	.30
1125—42 in.	3.00	.20
1126—42 in.	2.25	.15
1127—42 in.	3.00	.20
1129—42 in.	3.00	.20

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	44 yds.	Per yd.
1130—42 in.	\$ 5.00	\$.20
57 in....	6.50	.20

50 yds. Per yd.

	50 yds.	Per yd.
1132—36 in.	\$ 2.25	\$.071/2
42 in....	2.50	.071/2
48 in....	3.00	.08

20 yds. Per yd.

	20 yds.	Per yd.
1134—42 in.	\$ 2.60	\$.20
	44 yds.	Per yd.

	50 yds.	Per yd.
1135—42 in.	\$ 5.00	\$.20
57 in....	7.00	.25

	50 yds.	Per yd.
1137—36 in.	\$ 2.50	\$.10
42 in....	2.80	.15
62 in....	5.50	.20

	3.45	.10
1139—36 in.	4.00	.15
60 in....	6.35	.20

	4.05	.15
1140—36 in.	4.75	.15
42 in....	4.75	.15

	2.00	.15
1145—42 in.	\$ 2.00	\$.15
	20 yds.	Per yd.

	Page	Each	Page	50 yds.	10 yds.
1155—	4 x 7	\$.75	1197—	30 in.	\$ 35.60
6 x 9	.90	36 in.	38.70	8.80	
10 x 14	1.50	42 in.	52.80	11.90	
1158—	5 x 7	.25	54 in.	85.60	19.30
7 x 10	.40	1198—	30 in.	48.75	11.00
10 x 14	.90	36 in.	55.65	12.45	
14 x 20	1.50	42 in.	61.60	13.85	
1160—	12 x 16	1.80			Each
14 x 20	2.10	1200			\$.10
17 x 22	2.70	1202			.40
20 x 26	3.20	1205			1.75
23 x 31	4.50	1207			5.00
1161—	12 x 16	.90			
14 x 20	1.00				
17 x 22	1.20				
20 x 26	1.70				
23 x 31	2.30				

	Page 237	50 yds.	10 yds.
1180—	30 in.	\$ 5.00	\$ 1.25
36 in.	5.60	1.40	
42 in.	6.60	1.60	
1181—	30 in.	5.00	1.25
36 in.	5.60	1.40	
42 in.	6.60	1.60	
1182—	30 in.	5.50	1.40
36 in.	6.15	1.55	
42 in.	7.20	1.75	
1183—	30 in.	6.50	1.65
36 in.	7.70	1.85	
42 in.	9.15	2.20	
	54 in.	12.10	2.85

	Page 238	50 yds.	10 yds.
1184—	24 in.	\$ 6.50	\$ 1.65
30 in.	6.50	1.65	
36 in.	7.70	1.85	
42 in.	9.15	2.20	
54 in.	12.10	2.85	
1185—	30 in.	7.70	1.85
36 in.	8.80	2.20	
42 in.	10.05	2.40	
1186—	30 in.	6.50	1.65
36 in.	7.70	1.85	
42 in.	9.15	2.20	
54 in.	12.10	2.85	
1190—	30 in.	32.45	7.50
36 in.	35.00	7.90	
42 in.	48.60	11.00	
54 in.	80.00	18.15	
1191—	30 in.	45.75	10.25
36 in.	51.60	11.10	
42 in.	57.50	12.90	
1193—	Per lb.	.75	

	Page 239	50 yds.	10 yds.	10 yds.
1195—	30 in.	\$ 10.20	\$ 2.50	
36 in.	11.70	2.80		
42 in.	13.15	3.10		
54 in.	24.80	5.65		
1196—	30 in.	10.20	2.50	
36 in.	11.70	2.80		
42 in.	13.15	3.10		
54 in.	24.80	5.65		

	Page 239	50 yds.	10 yds.
1197—	30 in.	\$ 35.60	\$ 8.00
36 in.	38.70	8.80	
42 in.	52.80	11.90	
54 in.	85.60	19.30	
1198—	30 in.	48.75	11.00
36 in.	55.65	12.45	
42 in.	61.60	13.85	
		Each	
1200			\$.10
1202			.40
1205			1.75
1207			5.00

	Page 240	10 yds.
1215—	30 in.	\$ 3.50
36 in.		4.00
42 in.		4.50
1216—	30 in.	3.50
36 in.		4.00
42 in.		4.50
1217—	30 in.	17.50
40 in.		22.50
		Each
1220		\$.30
1221		.30
1222		.30
1223		.30
1225		.60

	Page 241	50 yds.
1180U—	30 in.	\$ 4.00
36 in.		4.50
42 in.		5.25
1181U—	30 in.	4.25
36 in.		5.25
42 in.		6.10
1182U—	30 in.	4.75
36 in.		5.25
42 in.		6.10
1183U—	30 in.	5.50
36 in.		6.50
42 in.		7.80
54 in.		10.50
1184U—	30 in.	5.50
36 in.		6.50
42 in.		7.80
54 in.		10.50
1185U—	30 in.	6.50
36 in.		7.50
42 in.		8.50

	10 yds.
1190U—	30 in.
36 in.	6.90
42 in.	9.10
54 in.	15.05
1191U—	30 in.
36 in.	9.65
42 in.	10.75

MOUNTING SERVICE

Mounting on cloth, single sheets.....	sq. ft.	\$.15
Mounting on cloth, matched sheets.....	sq. ft.	.16
Mounting on cloth cut to fold.....	sq. ft.	.30
Mounting Geological sheets to fold.....	each	.75
Mounting Geological sheets, cloth	each	.50
Mounting on Beaver Board.....	sq. ft.	.30
Common sticks	lin. ft.	.06
Half round sticks.....	lin. ft.	.08

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BLUE PRINTING

	Per Sq. Ft.
Paper prints from profile drawing cloth.....	\$.12
Paper prints from "Specifications" in lots of 25 or more, each.....	.07
Minimum charge for printing, 10c each print	
Cloth prints from transparent drawings up to 42 in. wide.....	.20
Cloth prints from transparent drawings over 42 in. wide.....	.25
Minimum charge, 25c each print	

BLUE-LINE PRINTING FROM NEGATIVES

Paper prints from negatives up to 42 in. wide.....	.07
Paper prints from negatives over 42 in. wide.....	.08
Minimum charge, 15c each print	
Cloth prints from negatives up to 42 in. wide.....	.25
Cloth prints from negatives over 42 in. wide.....	.30
Minimum charge, 25c each print	

NEGATIVE PRINTING OR BROWN-LINE POSITIVE PRINTING

Negative from Patent Office Drawing.....	
Minimum charge, 50c each print	
Alco Solar Paper prints, negative or positive, up to 42 in. wide.....	.12
Alco Solar Paper prints, negative or positive, over 42 in. wide.....	.15
Minimum charge, 25c each print	
Alco Solar Cloth prints, negative or positive, up to 42 in. wide.....	.50
Alco Solar Cloth prints, negative or positive, over 42 in. wide.....	.50
Minimum charge, 50c each print	
No bill rendered under 25c.	

LITHO PRINT PROCESS

Litho Prints on Tracing Cloth .....	.50
Litho Prints on Tracing cloth, 3 or more from same copy.....	.35
Litho Prints on Tracing Paper .....	.40
Litho Prints on Tracing Paper, 3 or more from same copy.....	.25
Litho Prints on Drawing Cloth .....	.40
Litho Prints on Drawing Cloth, 3 or more from same copy.....	.45

Size limit, 36x108 inches.

	Page 243	Each		Page 244	Each
1230—31 in.		\$1.70		1266E—36x60 in.	\$ 19.50
37 in.		1.85		1266F—42x60 in.	23.50
43 in.		1.95		1266G—42x72 in.	27.75
55 in.		3.00		1267A—20x26 in.	1.85
1231—31 in.		2.10		1267B—24x30 in.	2.50
37 in.		2.45		1267C—30x42 in.	4.00
43 in.		2.75		1267D—36x48 in.	5.25
55 in.		3.80		1267E—36x60 in.	6.50
1232—32 in.		.55		1267F—42x60 in.	7.35
37 in.		.60		1267G—42x72 in.	8.70
43 in.		.70			
	Doz.	Each			
1237—12 in.	\$2.15	\$.21			
18 in.	2.60	.26			
24 in.	2.90	.29			
36 in.	3.60	.36			
42 in.	4.10	.41			
48 in.	4.30	.43			
1238—12 in.	2.40	.24			
18 in.	3.10	.31			
24 in.	3.60	.36			
36 in.	4.30	.43			
42 in.	5.00	.50			
48 in.	5.00	.50			
1241—12 in.	.50	.05			
18 in.	.60	.06			
24 in.	.80	.08			
30 in.	1.00	.10			
36 in.	1.20	.12			
42 in.	1.40	.14			
1242—12 in.	.50	.05			
18 in.	.80	.08			
24 in.	1.20	.12			
30 in.	1.40	.14			
36 in.	1.60	.16			
42 in.	1.80	.18			
1243—12 in.	.60	.06			
18 in.	1.00	.10			
24 in.	1.20	.12			
30 in.	1.60	.16			
36 in.	2.00	.20			
42 in.	2.20	.22			
1244—12 in.	.80	.08			
18 in.	1.20	.12			
24 in.	1.40	.14			
30 in.	1.80	.18			
36 in.	2.20	.22			
42 in.	2.60	.26			
	Page 244			Page 248	Each
	Frame only	Frame with felt pad	Frame with pad and polished plate glass		
1265A—20x26	\$26.00	\$30.20	\$37.75		
1265B—24x30	32.00	38.30	49.75		
1265C—30x42	44.00	55.10	75.10		
1265D—36x48	58.50	73.70	103.70		
1265E—36x60	76.00	94.75	132.25		
1265F—42x60	83.00	105.40	145.50		
1265G—42x72	108.00	134.50	187.50		
1266A—20x26	in.	4.40			
1266B—24x30	in.	6.60			
1266C—30x42	in.	11.60			
1266D—36x48	in.	16.00			
	Page 249			Page 249	Dozen
					\$.50
					Each
1312					
1314—8 in.					\$ 2.20
10 in.					3.40
12 in.					4.20
14 in.					4.60
16 in.					6.00
1316—8 in.					3.60
10 in.					4.20
12 in.					7.00
15 in.					16.00
18 in.					25.00
24 in.					27.50
1317—33 in.					25.00

	Page 250	Each		Page 260	Each
1330		\$ 1.00		1466	\$4.50
1332	Per 100	Doz.	Each	1466C	5.75
	\$40.00	\$ 5.00	\$.50	1467	5.75
1335A	Per 100	Each		1467C	7.00
B	14.25	.15		1472NL	7.40
C	2.85	.03			
D	3.80	.04			
E	2.85	.03			
F	4.85	.05			
G	4.85	.05			
1336		28.50	.30		
	Page 254	Each		Page 261	Each
1400		\$1.65		1470-2	\$3.20
1401		1.80		1471	4.40
1402		2.00		1474- $\frac{3}{4}$	7.90
1400A		1.75		1474- $\frac{3}{4}$ H	9.75
1401A		1.95			
1402A		2.10			
1400SC		1.80			
1401SC		1.95			
1402SC		2.10			
	Page 255	Each		Page 262	Each
1406		\$2.50		1485- 4	\$.30
1407		2.75		5	.50
1408		3.00		6	.50
1410		2.15		7	.30
1411		2.45		8	.40
1412		2.65		9	.40
1410A		2.25		10	.50
1411A		2.60		11	.25
1412A		2.85		13	.40
				13 $\frac{1}{2}$	.35
				14	.40
				15	.50
				17	1.25
				18	1.50
				20	1.40
				21	1.50
				22	1.60
				23	1.60
				24	1.75
				25	1.90
				26	1.45
				27	1.20
	Page 256	Each		1486	.20
1414		\$2.20		1486R	.75
1415		5.40		1487A	.30
1416		4.80		1487B	.10
1424		1.75		1489A-F	.15
1425		3.40			
1426		1.20			
	Page 257	Each		Page 263	Each
1430S		\$2.65		1490 in case	\$15.50
1432S		3.45		1491 "	18.00
1434S		3.20		1492 "	23.50
1440C		3.15		1493 "	27.00
1442C		4.00		1490C	1.25
1444C		3.70			
	Page 258	Each		Page 264	Each
1451		\$ 4.00		1495C	\$13.30
1452		4.00		1496C	13.50
1454		4.00			
1454C		14.50			
	Page 259	Each		Page 265	Each
1461		\$ 4.00		1497	\$3.10
1462		4.00		1497C	3.75
1464		4.00		1498C	3.75
1464C		14.50		1499A—24 in.	.70
1465D		6.00		30 in.	.80
				36 in.	.90
				42 in.	1.05
				48 in.	1.20
				60 in.	1.60

	Page 265	Each		Page 277	Each
1499B—24 in.		\$.70		1611A	\$ 2.00
30 in.		.80		1612A	2.25
36 in.		.90		1633	3.50
42 in.		1.05		1633D	4.50
48 in.		1.20		1634	2.20
60 in.		1.60		1635	5.75
1499C—24 in.		.70		1637	4.00
30 in.		.80			
36 in.		.90			
42 in.		1.05		Page 278	Each
48 in.		1.20		1651	\$ 3.50
60 in.		1.60		1652	3.50
	Page 266	Each		1654	4.00
1500PB MACHAN		\$17.10		1654C	13.00
1503PB MACKLE		21.35		1661	4.00
	Page 267	Each		1662	4.00
1504PB MACRON		\$25.50		1664	4.25
	Page 268	Each		1664C	14.50
1505PB MADCAP		\$27.60		1665C	7.50
	Page 269	Each			
1508PB MAGENTA		\$35.10		Page 279	Each
	Page 270	Each		1666	\$ 4.00
1550		\$ 2.50		1666C	4.90
1551		2.75		1667	5.00
1552		3.15		1667C	6.00
1560		3.15		1668	4.75
1561		3.45		1668C	5.75
1562		3.75		1669	5.75
1564		3.45		1669C	6.75
1591		6.60			
1594 3/4 H		14.65		Page 280	Each
1594 3/4 H-SH		16.75		1680-1	\$ 3.25
	Page 271	Each		1680-2	4.30
1556SH		\$ 4.75		1681-1	4.40
1557SH		4.75		1681-2	5.00
1558SH		4.75		1680-3L	6.50
1556A-SH		4.75			
1557A-SH		4.75		Page 281	Each
1558A-SH		4.75		1682N	\$ 6.75
1570		3.45		1682NL	7.25
1571		4.00		1683N	7.00
1572		4.00		1683NL	7.50
1572SH		6.60		1684	8.00
1574		4.00		1684H	9.90
1580		4.30			
1581		5.15		Page 282	Each
1582		5.45		1685-1	\$ 1.10
1582SH		7.75		2	1.10
1584		5.15		3	1.10
1586SH		8.90		4	.30
1587SH		10.35		5	.50
	Page 276	Each		6	.50
1600		\$ 1.80		7	.30
1601		2.00		9	.25
1602		2.10		11	.25
1600C		1.90		13	.40
1601C		2.00		14	.40
1602C		2.20		15	.50
1604		2.40		16	.50
1608		2.00		18	1.50
				19	1.00
				20	1.40
				21	1.50
				22	1.60
				23	1.60
				24	1.75
				25	1.90
				26	1.25
				27	1.50

	Page 283	Each		Page 297	Each
1690		\$ 2.75	1790C		\$ 9.00
1691		2.00	1791C		12.50
1692		2.25	1792C		22.50
1693		7.50	1790½		1.00
1694		3.00		Page 298	Each
1695-1		7.00	1795		\$ 9.50
1695-2		7.50	1795C		11.00
1695-3		8.25	1796		9.50
	Page 284	Each	1796C		11.00
1696		\$16.25	1797		2.75
1696ED		23.00	1797C		3.00
1697		21.00	1798C		3.00
1697ED		27.00		Page 299	Each
1698		12.75	1796½		\$ 8.75
1699		8.75	1796½C		10.00
	Page 285	Each	1800C		17.50
1608PB	MOCHA	\$10.40	1801C		19.00
1612PB	MODAL	19.50	1802C		25.85
	Page 286	Each	1800½		2.50
1613PB	MOHAIR	\$26.00		Page 300	Each
	Page 287	Each	1824PBS	NAILGUN	\$18.50
1621PB	MOIRE	\$30.00			
1621PBH	MOLAR	31.90	1825PBC	NAINSOOK	\$20.70
	Page 288	Each		Page 302	Each
1623PBH	MOLDER	\$40.00	1840		\$ 1.10
	Page 289	Each	1841		1.20
1624PB	MONAD	\$30.50	1842		1.30
1624PBH	MONARCH	32.40	1840SC		1.35
1625PB	MONDAINE	32.40	1841SC		1.50
1625PBH	MONGOOS	34.30	1842SC		1.60
	Page 290	Each		Page 303	Each
1626PB	MONITOR	\$34.50	1850		.90
1626PBH	MONITRESS	36.40	1852		1.20
	Page 291	Each	1854		1.10
1627PBH	MONOLITH	\$47.50	1860		2.35
	Page 292	Each	1862		2.65
1628PB	MONORAIL	\$40.00	1864		2.50
1628PBH	MONOTYPE	41.90		Page 304	Each
	Page 293	Each	1880-2S		\$ 1.40
1629	MONOXIDE	\$62.50	1881S		2.15
	Page 294	Each	1884¾S		4.75
1725PBG	MOORSTONE	\$19.50		Page 305	Each
	Page 295	Each	1880-2R		\$ 1.50
1700SH		\$ 3.10	1881R		2.25
1701SH		3.25	1884¾R		4.90
1702SH		3.40		Page 306	Each
1723		5.90	1890PBS	OAKUM	\$ 7.75
1784P		6.90	1892PBS	OPAL	9.50
	Page 296	Each		Page 307	Each
1780-2		\$ 2.40	1893PBS	OROIDE	\$ 8.75
1781		3.60	1893PBR	ORPIN	10.50
1784		6.50		Page 308	Each
			1893-3PBR	ORRIS	\$11.50
				Page 309	Each
			1894PBR	OSPREY	\$12.30

	Page 310	Each		Page 323	Each
1894PBS	OXYGEN	\$10.10	1985-4		\$.25
	Page 311	Each	5		.40
1895PBN	OXYTONE	\$12.30	6		.40
	Page 312	Each	7		.30
1900		\$.65	8		.25
1901		.75	9		.25
1902		.85	10		.50
1900C		.75	11		.20
1901C		.85	13		.35
1902C		.90	13½		.30
	Page 313	Each	14		.35
1910		\$.75	15		.40
1912		1.00	20		1.10
1914		.90	21		1.20
1910R		.75	22		1.25
1912R		1.00	23		1.25
1914R		.90	24		1.40
1915R		1.35	25		1.65
	Page 314	Each	26		1.00
1930-2		\$1.20	27		1.10
1931		.75	1987		.10
1934 ¾		3.10		Page 327	Each
	Page 315	Each	2000	SABOT	\$20.50
1953PBR	PAGODA	\$ 6.55	2001	SACHEM	18.50
	Page 316	Each	2005	SACKBUT	35.00
1955PBR	PALADIN	\$ 8.20	2006	SACRUM	54.00
	Page 317	Each		Page 328	Each
1955PBS	PALISADE	\$ 9.15	2010	SAFFRON	\$41.50
	Page 318	Each		Page 329	Each
1960		\$.50	2015	SAGAMORE	\$44.00
1961G		1.00		Page 330	Each
1964G		2.25	2020	SAGAS	\$26.20
1968		4.50	2021	SAGUM	40.00
1969		6.00	2022	SAIGA	45.00
	Page 319	Each		Page 331	Each
1971BLG	PROCTOR	\$ 2.85	2025	SALLET	\$135.00
1974BLG	PROLATE	4.00	2028	SALLY	240.00
	Page 320	Each		Page 332	
1977 ½ PBR	RADIX	\$ 5.00	2029	SALPINX	\$160.00
1978PBR	RAFTER	5.60	2030	SALTANT	148.00
	Page 321	Each		Page 333	Each
1979PBR	RAGSTONE	\$ 6.25	2035	SALVO	\$32.00
	Page 322	Dozen	2040-A		.75
1982		\$10.80	B		.75
1983		13.50	C		.75
1986		6.00	D		.75
1988		1.10	E		1.00
		.50	F		1.00
		.10	G		.75
			H		.75
			I		.75
			J		.75
			K		.75
			2041		8.50
			2042-A		1.75
			B		1.75
			C		1.75
			D		1.75
			E		1.75

	Page 334		Page 344	
	Price on application		Each	
2045.....	Price on application		2128	\$29.00
2046.....	Price on application		2129	34.00
	Page 335		2118	5.40
2055.....	Price on application		2135	18.00
	Page 336	Each	2136	21.00
2075 SANDPIPE	\$205.00		2137	26.00
2076 SANDSPIT	215.00		Morocco Case for 2135	4.50
	Page 337	Each	Morocco Case for 2128 or 2136	4.50
2080 SARCINE	\$100.00		Morocco Case for 2129 or 2137	5.00
2081 SARCODE	110.00			
2082 SARCOMA	123.00			
	Page 338	Each	Page 345	Each
2085 SATIRIST	\$56.00		2150	\$10.50
2087 SATRAP	63.50		2151	2.50
	Page 339	Each	2156	10.50
2090	\$ 5.80		2157	2.50
2092	3.40			
2094	1.80		Page 346	Each
2095	1.70		2160	\$ 1.85
2096	1.00		2161	2.30
2097 .....	.50		2162	3.00
2099	7.90		2163	3.40
	Page 340	Each	2165	4.75
2101C SATURN	\$50.00		2171	2.65
2101D SATYR	30.00		2172	4.00
	Page 341	Each	2173	4.40
2103	\$ 3.00			
2104	3.25		Page 347	Each
2105	5.50		2180	\$.75
2106	2.50		2181	1.10
2107	3.00		2182	1.40
	Page 342	Each	2184	2.15
2110	\$140.00		2189	.20
2116	29.50		2190	.30
2117	35.00		2191	.60
2118	5.40		2192	.80
	Page 343	Each	2193	1.10
2120	\$22.50		2201	.30
2121	24.00		2202	.20
2122	29.50		2203	.40
2126	9.40		2204	.20
Morocco Case for 2120.....	4.00		2205	.30
Morocco Case for 2116 or 2121.....	4.00		2202M	.40
Morocco Case for 2117 or 2122 ..	5.00		2203M	.70
	Page 344	Each	Page 348	Each
2210			2210	\$ 3.50
2211			2211	4.50
2215			2215	5.70
2216			2216	6.70
2217			2217	8.20
2230			2230	.45
2231			2231	.60
2232			2232	.75
2234			2234	1.50
2235			2235	2.60
	Page 349	Each		
2241			2241	\$ 4.50
2246			2246	1.00
2247			2247	1.35
2250			2250	1.10
2252			2252	1.75
2255			2255	1.50
2256			2256	.85
	2260-65			

HARDENED JOINT AND SOLID ROD DRAFTING MACHINES

Prices of Machine only, without scales.

	Standard Protractor	Architect's Protractor	Civil Eng'r's Protractor
Mid-Anchor, sizes 18, 21, 24 or 28.....	\$62.50	\$65.00	\$ 92.50
Corner Anchor, sizes 18, 21, 24 or 28.....	60.00	62.50	90.00
Mid-Anchor, sizes 32 and 36.....	70.00	72.50	100.00
Corner Anchor, sizes 32 and 36.....	67.50	70.00	97.50

BALL BEARING TUBULAR ROD DRAFTING MACHINES

Prices of Machine only, without scales.

	Standard Protractor	Architect's Protractor	Civil Eng'r's Protractor
Mid-Anchor, sizes 18, 21, 24 or 28.....	\$77.50	\$80.00	\$107.50
Corner Anchor, sizes 18, 21, 24 or 28.....	75.00	77.50	105.00
Mid-Anchor, sizes 32 and 36.....	85.00	87.50	115.00
Corner Anchor, sizes 32 and 36.....	82.50	85.00	112.50
Standard or Architect's Protractor, with vernier to 5 minutes extra....			3.50

THE JUNIOR DRAFTING MACHINEPrice without
Scales

Mid-Anchor, Standard Protractor.....	\$27.00
Corner Anchor, Standard Protractor.....	25.00

FLAT WHITE-EDGE SCALE WITH CHUCKING PLATES FOR U. D. MACHINES

24 in.....	\$4.35	12 in.....	\$2.50
18 in.....	3.50	6 in.....	2.00

STRAIGHT EDGES WITH CHUCKING PLATES FOR U. D. MACHINES

	Ebony Lined	Amber Lined
12 in.....	\$1.50	\$2.25
18 in.....	1.75	2.50
24 in.....	2.00	2.75

Page 354	Each	Page 355	Each
2301.....	\$.85	2372— 6 in.....	\$.35
2302.....	1.10	12 in.....	.50
2307.....	1.60	18 in.....	.65
2312.....	2.25	24 in.....	1.10
2321.....	.85		
2322.....	1.10		
2327.....	1.10		
2332D.....	1.15		

Page 355	Each	Page 356	Each
2341.....	\$ 2.00	2302X.....	\$ 1.80
2342.....	3.10	2307X.....	2.70
2344.....	8.40	2322X.....	1.80
2347.....	3.45	2327X.....	1.80
2352.....	3.60	2341X.....	2.35
2361.....	2.00	2342X.....	3.50
2362.....	3.10	2343X.....	7.00
2367.....	3.10	2344X.....	9.00
2370.....	.35	2347X.....	3.90
2371— 6 in.....	.50	2352X.....	3.90
12 in.....	.65	2361X.....	2.35
18 in.....	.85	2362X.....	3.50
24 in.....	1.10	2363X.....	7.00
		2364X.....	9.00
		2367X.....	3.50
		2368X.....	7.00
		2369X.....	9.00

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	Each
2380	\$ 1.20
2381	1.50
2382	4.00
2385	3.00
2386	3.75
2387	7.50
2390	.65
2391	.90
2392	1.00
2393	2.00
2395	1.00
2396	1.40
2397	1.70
2398	3.00
2400	10.50
2401	18.00
2402	14.40
2403	23.75

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	Each
2410	\$.70
2412	.70
2413	.70
2415	1.00
2417	1.00
2418	1.00
2440	.70
2441	1.00
2447	1.00
2451	1.00
2461	1.75

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	Each
2479	\$ 1.10
2480	1.00
2481	1.00
2487	1.70
2488	1.70

Page 360

	Each
2510	\$ 1.00
2512	1.00
2513	1.00
2514	1.50
2515	1.80
2517	1.80
2518	1.80
2519	2.10
2520	1.80
2521	1.80
2522	1.80
2523	2.10
2530	1.80
2531	1.80
2532	1.80
2533	2.10

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	Each
2540	\$ 1.00
2541	1.80
2542	2.00
2544	4.30
2546	1.00
2547	1.80
2549	4.30
2551	1.80
2561	2.80
2563	6.50

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	Each
2570	\$ 1.85
2572	1.85
2573	1.85
2574	1.85
2575	2.25
2576	1.10
2577	1.85
2578M	2.50
2579M	2.50
2580	1.75
2581	1.75
2584	2.75

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	Set
2604	\$ 7.50
2608	12.50
2612	17.20
2624	8.00
2626	11.00
2628	13.75

Page 364

	Set
2634	\$ 10.00
2638	17.20
2642	24.50
2654	10.40
2656	15.00
2658	19.00

Page 365

	Each
2660	\$.35
2663	2.50
2664	3.30
2665	Set 1.80
2666	Each .25 Set 1.35
2667	Each .25
2668	.30
2669	.30

	Page 366	Each	Page 370	Each
	Dozen	Each		
2670—12 in.		\$.15	2756	\$.60
15 in.		.20	2756W	.65
18 in.		.25	2762	.20
2672—12 in.		.25	2762W	.20
15 in.		.30	2763	.30
18 in.		.40	2763W	.35
			2764	.40
2674		\$.50	2764W	.45
2676		.35	2766	.60
2677		.45	2766W	.65
2679		.65		
	Page 367	Each	Page 371	Each
2680		\$ 4.25	2793	\$ 1.10
2685		.65	2794	.50
2686		.95	2796	2.20
2687		1.85	2801	.55
2702		1.80	2802	1.10
2703		2.10	2803	1.65
2704		2.40	2811	.55
2705		3.60	2812	1.10
			2813	1.65
			2821	.55
			2822	1.10
			2823	1.65
2710		\$ 4.80	2831	.15
2712		6.00	2832	.15
2720			2833	.15
2721		19.50		
	Page 368	Each	Page 372	Each
			2860	\$ 1.25
2710		\$.45	2862	1.80
2712		.50	2863	2.00
2720		1.50	2864	2.75
2721		19.50	2865	4.00
			2890	8.00
			2891	10.00
			2932	17.00
			2934	24.00
			2935	33.00
	Page 369	Each	Page 373	Each
2725		\$.30	2940	\$ 3.25
2726		.45	2948	4.25
2727		.90	2949	4.75
2728		1.10		
2728½		1.50		
	Page 370	Each	Page 375	Each
2732		\$.20	2960	\$ 6.00
2732W		.20	2960M	5.50
2733		.30	2964	5.50
2733W		.35	2965	12.00
2734		.40	2967	13.00
2734W		.45	2969	17.50
2735		.50	3060H	.30
2735W		.55		
2736		.60		
2736W		.65		
2738		.80		
2738W		.90		
2743		.30		
2743W		.35		
2744		.40		
2744W		.45		
2745		.50		
2745W		.55		
2746		.60		
2746W		.65		
2748		.80		
2748W		.90		
2754		.40	Instruction Book	.50
2754W		.45	2973	3.50
2755		.50	2973L	4.00
2755W		.55	2974	4.00

	Page 377	Each		Page 386	Each
2975		\$ 1.50	3097		\$ 1.40
2980		6.75	3098		1.40
2980M		6.25			
2984		6.25			
2985		13.50			
2989		17.50			
	Page 378	Each		Page 387	Each
2994		\$ 12.00	3104		\$ 1.50
3024		8.00	3110		6.50
3029		20.00	3111		16.00
	Page 379	Each	3112		.65
3034		\$ 8.50			
3044		10.00			
	Page 380	Each		Page 388	Each
3060A		\$.75	3155— 8 in.		.25
3060B		1.00	10 in.		.35
3062A		.40	12 in.		.40
3062B		.50	3156— 6 in.		.25
3070		2.50	8 in.		.35
3071		3.00	10 in.		.40
3072		2.50	3175— 8 in.		7.50
3073— 5 in.		.45	10½ in.		8.50
10 in.		.65	15 in.		13.00
16 in.		1.00	3176— 8 in.		8.50
20 in.		1.25	10 in.		11.25
3074A— 5 in.		1.15	12 in.		13.00
10 in.		1.50			
16 in.		2.50			
20 in.		2.75			
3074B— 5 in.		2.50			
10 in.		3.00			
16 in.		4.00			
20 in.		4.25			
BK. 1		.50			
BK. 2		1.00			
BK. 3		.75			
BK. 4		1.00			
	Page 381	Each	3180- 4		.35
3075		\$ 7.50	5		.45
3075G		2.00	7		.50
3080		8.20	8		.60
	Page 382	Each	9		.70
3082		\$ 6.00	10		.85
	Page 383	Each	12		1.10
3090		\$ 28.50	14		2.50
	Page 384	Each	16		3.40
3092		\$ 9.75	18		3.90
3092A		1.00			
3092B		3.25			
3092C		2.50			
3092D		2.25			
3092X		17.75			
	Page 385	Each			
3094		\$ 7.50			
3095		7.50			
3096		2.75			
	Page 389	Each			
3192- 7		\$ 4.50			
10		6.75			
3193- 8		1.25			
11		1.75			
	Page 391	Each	3194		\$ 1.00

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3200	Per set	\$ 3.25
3201	" "	3.00
3205	" "	4.00
	Each	.80
3208	Per set	6.00
	Each	1.20
Double Slope		1.40

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Each

3320—Full sheets, 20x50.....	\$ 12.00
Running inch30
Square inch02 1/2
3221—Full sheets, 20x50.....	9.00
Running inch .....	.20
Square inch .....	.01 1/2
3222—Full sheets, 20x50.....	6.00
Running inch .....	.15
Square inch .....	.01

3223 and 3224—

Full sheets, 20x50.....	3.00
Running inch10
Square inch00 1/2

Amber

3230	4.30
3232	5.50
3233	4.30
3234	9.20

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Each

3240	\$ 2.40
3242	1.50
3244	2.50
3246	1.50

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Each

3250- 1	\$.35
2	.40
3	.45
4	.45
3251- 1	.60
2	.65
3	.70
4	.75
5	.75
6	.75
7	.75
8	.60
9	.75
10	.90
11	.60
12	.20
13	.00

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Each

3255-36	\$.85
42	1.00
48	1.15
60	1.45
3256-24	.70
30	.85
36	.90
42	1.10
48	1.40
60	1.40

3260	2.75
3265	31.90

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Each

3270	\$.45
3271	1.00
3272	1.85
3275	1.95
3276	2.65
3278	2.25
3279	3.75

Pattern No.	Page 399	Each
3290 -1	\$ 1.50	
2	1.50	
3	1.50	
4	1.50	
5	1.50	
6	1.50	
7	1.50	
8	1.50	
9	1.50	
10	1.50	
11	1.50	
12	1.50	
13	1.50	
14	1.50	
15	1.50	
16	1.50	
17	1.50	
18	1.20	
19	.90	
20	.90	
21	.90	
22	.80	
23	.80	
24	1.20	
25	.80	
26	1.50	
27	.90	
28	.90	
29	.90	
30	.80	
31	.90	
32	.90	
33	.90	
34	.90	
35	.90	
36	.65	
37	.65	
38	.65	
39	.65	
40	.65	
41	.65	

Pattern No.	Page 399	Each	Pattern No.	Page 399	Each
42		\$.65	108		\$.65
43		.65	109		.65
44		.65	110		.65
45		.65	111		.65
46		.65	112		.65
47		.65	113		.60
48		.65	114		.65
49		.65	115		.65
50		.65	116		.65
51		.65	117		.65
52		.65	118		.65
53		.65	119		.65
54		.65	120		.65
55		.65	121		.65
56		.65	3290A	Per set	50.00
57		.80	B	" "	86.00
58		.90			
59		.90			
60		.80			
61		.80			
62		.65			
63		.65			
64		.60			
65		.65			
66		.65			
67		.65			
68		.75			
69		.65			
70		.65			
71		.65			
72		.50			
73		.55			
74		.50			
75		.55			
76		.65			
77		.65			
78		.65			
79		.80			
80		.90			
81		.65			
82		.80			
83		.65			
84		.55			
85		.65			
86		.65			
87		.60			
88		.40			
89		.60			
90		.60			
91		.50			
92		.50			
93		.40			
94		.40			
95		.40			
96		.40			
97		.40			
98		.50			
99		.65			
100		.65			
101		.65			
102		.65			
103		.65			
104		.65			
105		.65			
106		.60			
107		.50			

	Page 404	Each		Page 406	Each
3356- 18		\$ 1.25	3395-15		\$ 1.60
24		1.70	18		1.80
30		2.00	24		2.25
36		2.30	30		2.90
42		2.80	36		3.40
48		3.50	42		3.90
54		4.75	48		4.75
60		6.45	54		6.40
72		10.80	60		8.10
3358 -15		3.60	72		11.00
12		4.30	18		2.50
24		6.30	24		3.00
30		7.25	30		3.90
36		9.60	36		4.40
42		12.00	42		5.00
48		15.00	48		5.70
54		21.00	54		6.80
72		25.00	60		8.25
3360 -15		3.10	72		10.00
18		3.40	18		13.70
24		4.00	24		1.50
30		5.00	30		2.00
36		6.50	36		2.50
42		8.40	42		3.00
48		10.40	48		3.30
60		15.25	54		4.30
72		21.00	60		
	Page 405	Each	3397-18		
3370-15		\$.35	3398-18		
18		.40	24		
21		.50	30		
24		.60	36		
30		.70		Page 407	Each
3371-24		1.25	3399-24		\$ 5.75
30		1.40	30		6.00
3373-24		.70	36		6.40
30		.90	42		7.20
36		1.10	48		8.40
42		1.25	3410-20		7.00
3375-15		.60	24		8.00
18		.75	30		10.20
24		1.00	36		12.25
30		1.20	42		15.00
36		1.40	3414-24		19.50
42		2.00	30		21.00
	Page 406	Each	36		23.75
3378-24		\$ 1.20	42		26.50
30		1.40	6		3.25
36		1.80	8		4.00
42		2.00	12		6.50
48		2.40	3417- 6		5.00
60		3.65	8		5.60
72		4.70	12		8.50
3379-24		2.20		Page 408	Each
30		2.35	3420-24		\$ 6.50
36		2.65	30		6.75
42		2.95	36		8.20
48		3.35	40		9.20
60		4.75	48		11.00
72		6.30	60		13.75

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3428—Price edges only.	Each	3475	\$ 6.00
36	\$ 3.30	3476	6.50
42	4.25	3477	7.00
48	6.50	3478	8.00
55	8.25	3479	1.60
60	9.00	3480	1.80
72	11.50	3484	17.50
84	15.00		

3429—Attachment only

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3430	Each	3486	Each
3431	\$ 6.00	3486A	.15
3432	7.00		
3435	8.00		
3436	1.00		
3437	1.55		
	2.10		

Page 410

3440—12x17	Each	3488	Each
16x21	1.25	3489A	\$ 17.50
18x24	1.80	B	25.50
19x25	2.25	D	35.00
20x26	2.50		
23x31	2.75		
31x42	3.80		
3442—15x20	1.00	3490B	\$ 27.75
20x26	1.80	C	32.50
20x30	2.00	D	39.50
30x40	4.00		
3445—12x17	1.35		
16x21	2.10		
20x26	3.05		
23x31	4.20		
31x42	7.40		

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3450—31x 42	Each	3492	Each
33x 55	\$ 11.00	3493	42.50
36x 48	16.50		
36x 60	14.25		
36x 72	17.50		
36x 84	20.00		
42x 60	22.50		
42x 72	20.00		
42x 84	22.50		
42x 96	26.50		
48x 72	28.00		
48x 84	25.00		
48x 96	30.00		
48x 108	35.00		
48x 120	40.00		
54x 96	47.50		
54x 108	45.00		
54x 120	47.50		
60x 96	50.00		
60x 108	45.00		
60x 120	55.00		

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3452—16x21	Each	3506	Each
20x26	\$ 4.50	3507A	\$ 21.50
23x31	6.20	3507B	6.00
31x42	8.00		1.90
33x55	14.00		
36x60	21.75		
	25.50		
3454A	5.40		
3454B	8.00		

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3475	\$ 6.00	3525—31x42	Each
3476	6.50	33x55	60.00
3477	7.00	36x48	58.50
3478	8.00	36x60	62.00
3479	1.60	36x72	68.00
3480	1.80	42x60	68.00
3484	17.50	42x72	70.50
		48x72	73.00
		3525A	50.00

	Page 424	Each
3528		\$ 88.70
3529		100.00
	Page 425	Each
3530		\$ 94.55
3530S		87.55
3531		91.00
3531S		85.50
	Page 426	Each
3532		\$131.50
3532S		120.60
3533		150.90
3533S		145.40

	Page 427	Each
3537		\$124.60
	Page 429	Each
3546—32B		\$ 15.00
32C		37.80
32D		35.40
32EE		21.00
32G		8.20
32H		9.70
32J		16.25
32K		30.90

	Page 430	Per pair	Each
3546		\$.30	
3547		.Each	1.65
	Page 431	Each	
3548A		\$119.25	
3548B		128.75	
3549A		85.90	
3549B		95.50	

	Page 433	Each
1833		\$ 23.75
1834		51.00
1835		10.50
22D		87.50
1825		40.50
1826		58.75
1829		79.75
1830		71.00
1831		61.25
1836		84.50
1837		9.50
25D		13.75
1838		11.25
1839		15.75
1851		28.25
1852		66.75
1853		13.00
27D		96.50
1843		45.75
1844		65.25
1847		91.75
1848		79.25
1849		68.75
1854		95.00
1855		10.50
30D		15.50
1856		12.50
1857		18.00

	Page 435	Each
3560		\$258.00
3561		234.50
3562		171.50
3563A		6.75
3563B		15.50
3563C		8.50
3563D		8.50
3563E		44.00
3565A		3.40
3565B		1.75
3566		1.65
3567		.55

	Page 436	Each
3579A		\$ 5.00
3579B		6.00
3580A		4.00
3580B		4.50
3580D		7.00
3581A		11.75
3581B		12.50
3582A		13.75
3582B		15.00
3585		2.00

	Page 437	Each
3600— 3 oz.		\$.20
6 oz.		.35
14 oz.		.70
½ gal.		2.40
1 gal.		4.00
3605— 4 oz.		.20
8 oz.		.35
3610— 2 oz.		.15
4 oz.		.25
3612—½ lb.		.25
1 lb.		.40

	Page 438	Each
3618		\$.25
3618HP		2.00
3618P		3.75
3618Q		7.00
3625		.25
3625HP		2.00
3625P		3.75
3625Q		7.00

	Dozen	
3630		\$2.10 .20
3631		1.20 .10

	Page 439	Each
3632		\$.25
3632HP		2.00
3632P		3.75
3632Q		7.00

	Page 440	Each
3635		\$ 2.00
3636		.75
3638		1.00
3640		.85

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Each

3645A		\$.20
3645B		.50
3645E		.35
3651		.85
3662		.15

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Gross Dozen

170—Loose	\$ 2.00	\$.20
290— "	7.50	.75
291— "	7.50	.75
303— "	2.00	.20
404— "	1.25	.15
659— "	7.50	.75
290—Cards	10.00	1.00
291— "	10.00	1.00
659— "	10.00	1.00
850— "	12.00	1.20
1000— "	24.00	2.40

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Gross Dozen Each

22	\$ 1.75	\$.20
56	1.75	.20
71	1.75	.20
99	1.75	.20
100	5.00	.50
101	5.00	.50
102	5.00	.50
107	5.00	.50
102 Carded	12.00	1.20
107	12.00	1.20
512	1.75	.20
513	1.75	.20
513EF	1.75	.20
514	1.75	.20

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Gross Dozen Each

506F	\$ 2.25	\$.20
506EF	2.25	.20
516F	2.25	.20
516EF	2.25	.20
526	2.25	.20
Spencerian No. 1	1.75	.20
Spencerian No. 9	1.75	.20
3690	11.00	1.10
3695		.10
3696		.60
3697		.05
	1.00	.10

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Gross $\frac{1}{4}$ Gross Dozen

3725	\$ 1.50	\$.40	\$.15
3725A		Per card	.30

Gross $\frac{1}{4}$ Gross Dozen

3727	\$ 2.00	\$.55	\$.20
		Per box	Each

3730		\$.65	\$.07
3731			.10

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Each

3737		\$.25
3738		.25
3739		1.00
3740		.85

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Each

3741		\$ 2.75
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Dozen Each

3742A		\$ 1.20	\$.10
3742B		1.20	.10
3742C		1.20	.10
3742SA		Per box	.50
3742SB		" "	.50
3742SC		" "	.50

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Dozen Each

3746		\$ 1.00	\$.10
3747		1.00	.10
3749		.80	.08
3751		.80	.08
3752		.90	.10

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Gross Dozen Each

3760		\$ 14.00	\$ 1.50	\$.15
3762				.40
3765		Per box		.80

3770		Gross	Dozen	Each
		\$ 10.00	\$ 1.00	\$.10

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Gross Dozen Each

3776		\$ 14.00	\$ 1.50	\$.15
3778		14.00	1.50	.15
3780		10.00	1.00	.10
3788		7.20	.60	.05
3795		6.50	.60	.05

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Gross Dozen Each

3796		\$ 5.40	\$.50	\$.05
3800A		16.20	1.50	.15
3800B		14.40	1.40	.15
3801		16.20	1.50	.15
3802		16.00	1.50	.15
3803		16.00	1.50	.15

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Dozen Each

3805		\$ 6.00	\$.50
3806		6.00	.50
3807		9.00	.75
3808	15 leads	1.80	.15
3809		1.80	.15

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Gross Dozen Each

3810		\$ 1.80	\$.15
3815		1.00	.10
3817		1.20	.10
3820		.50	.05
3828		\$ 2.00	.20
3829		1.50	.15

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	Gross	Dozen	Each
3830	\$ 5.00	.50	.05
3831	10.00	1.00	.10
3833		2.00	.20
3844			.50
3845			.15
3846			.20

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	Each
3847	\$2.00
3849	5.20
3849DC	6.20

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	Dozen	Each
3850	\$1.50	.15
3850-12		.15
3850-24		3.00
3850-36		4.50
3850-60		7.50

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	Gross	Dozen	Each
3852		\$1.00	.10
3852-7			.65
3852-12			1.10
3852-24			2.15
3858		\$1.80	.15
3860A	\$10.50	1.00	.10
3860B	10.50	1.00	.10
3861A	10.50	1.00	.10
3861B	10.50	1.00	.10
3861C	10.50	1.00	.10

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	Gross	Dozen	Each
3862A	\$15.00	\$1.50	.15
3862B	15.00	1.50	.15
3862X	15.00	1.50	.15
3871A	14.40	1.20	.10
3871B	14.40	1.20	.10
3871C	14.40	1.20	.10
3871D	14.40	1.20	.10
3873			.35
3875			.50

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	Dozen	Each
3880A	\$.	\$.15
3880B		.40
3880C		.80
3880D		3.20
3883A	.50	.05
3883B	.90	.10
3883C	1.25	.15
3883D	2.80	.25
3883E	6.00	.50
3884A	.55	.05
3884B	1.10	.10
3885-60		.05
3885-40		.06
3885-30		.08
3885-24		.10
3885-20		.12
3885-16		.15
3885-12		.20
3885-8		.30
3885-4		.60

Per lb.

2.00 3966

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	Dozen	Each
3888A		\$.55
3888B		1.10
3892A		.55
3892B		1.10
3894A		.55
3894B		1.10
3895		.50
3896		1.10

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	Dozen	Each
3898A		\$.55
3903		1.20
3905		20.00
3906- 6		\$1.00
3906- 7		1.00
3906-12		1.00

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	Each
3909	\$.50
3910	.50
3911	.70
3913	.85
3914	1.00
3915	1.20

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	Dozen	Each
3922		\$2.50
3924		2.00
3926		2.50
3927		4.50
3929		2.00

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	Each
3932	\$1.30
3933	.95
3934	.65
3935	.50
3936	Per lb.
3938A	3.00
3938B	.50

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	Gross	Dozen
3940		\$.60
3941		.70
3942		.90
3944		.60
3945		.70
3946		.90
3960	\$1.65	.15
3961	1.80	.20
3962	2.00	.25
3966	3.50	.30

	Page 467	Per 100
3970		\$.35
3971		.40
3972		.50
3972 1/2		.60
3973		.75
	Per box	
3974		\$.10
	Per 100	
3976		\$.30
3977		.35
3978		.40
	Each	
3980		\$.05
3981		.30

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	Per 100	Per 1000
4008-1	\$.20	\$ 2.00
2	.25	2.50
3	.30	3.00
4	.35	3.50
5	1.10	9.75
6	1.20	10.80
4009	.20	2.00
	Box	Per 1000
4012	\$.10	\$.90
	Dozen	Each
4014A	\$.50	\$.05
4014B	1.00	.10
4014C	2.00	.20

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	Each
4017	\$3.50
	Per box
4017A Short	\$.35
Medium	.45
Long	.60
	Each
4019	\$3.50
	Per M
4019A	\$.50
	Each
4042	\$.75
4044	1.15
4046	2.65

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	Per box	
4050	\$.70	
	Dozen	Each
4063	\$2.00	\$.20
4066-2	.45	.05
4066-4	.60	.05
4066-6	.75	.08
4066-8	1.00	.10
4068	.20	
4072	2.20	.20
4075	3.00	.25
4078	3.00	.25

Page 471	Dozen	Each
4101	\$ 4.75	\$.40
4101 1/2	3.50	.30
4102	9.50	.80
4102 1/2	4.75	.40
4103	11.70	1.00
4103 1/2	6.50	.55
4104	17.50	1.50
4104 1/2	9.50	.80
4105	31.75	2.65
4105 1/2	15.90	1.35

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Page 472	Dozen	Each
4110	\$4.50	\$.40
4111	6.20	.55
4113	8.20	.70
4120	—	1.00
4140-12	—	1.70
4140-16	—	1.85
4140-20	—	2.00
4140-24	—	2.20
4140-32	—	2.45
4140-36	—	2.75
4141- 6	—	1.70
4141- 8	—	1.85
4141-10	—	2.00
4141-12	—	2.20
4141-16	—	2.45
4141-18	—	2.75
4141-24	—	3.00

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Page 473	Each
4151	\$.70
4152	.85
4153	1.30
4154	1.65
4155	2.15
4160-18	5.00
4160-24	6.50

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Page 474	Each
4166	\$1.00
4169	2.00

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Page 475	Each
4174	\$2.25
4176	.55
4177	.65
4178	.65
4179	.85
4184	.40

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Page 476	Each
4190	\$.20
4191	.45
4194	.35
4195	.75
	Per Set
4200	\$1.50
4201	1.70
4202	1.90
4203	2.10
	Each
4206	\$.25
4208	.50
4209	.10

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4212-0		Each	\$.25
1			.25
2			.30
3			.35
4			.40
5			.55
6			.70
7			.80
8			1.00
9			1.25
10			1.65
11			2.00
12			2.50

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4213-1		Each	\$.20
3			.25
5			.35
7			.45
9			.65
11			.70
12			.80

4216C		Per card	
			\$2.00

Page 479 Dozen Each

4215-1		Each	\$.15
2			.15
3			.20
4			.20
5			.20
6			.25

4216-1		Each	\$.70
2			.80
3			.85
4			.90
5			1.00
6			1.10

4217-0		Each	\$.40
1			.45
2			.50
3			.65
4			.80
5			1.00
6			1.25

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5000		Each	\$.15
5005			.30
5006			1.00
5010			.60
5012			.15
5014 (Each sheet)			.30
5016			.30

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5018		Each	\$.60
5020			.40
5022			.60
5024			.60
5026 (Each sheet)			.30
5028			.60
5028 (Between covers)			.70
5030			.30
5040			.25
5042			.15

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5050		Each	\$1.25
5052			.75
5054			1.25

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5056		Each	\$.20
5058			.20
5060			.10
5062			.02
5070			.35
5075			.50

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6000	(2 volumes)	Each	\$10.00
6002			7.00
6004			1.25
6006			10.00
6010			6.00
6012A			2.50
6012B			6.00
6012C			6.00
6014			4.00
6020			6.00
6024			2.25
6030			5.00
6032			6.00
6034			6.00

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6040		Each	\$ 2.50
6042			2.50
6044			4.00
6046			2.50
6048			2.25
6050			1.75
6052			6.00
6054			7.00
6056			4.00
6058A			2.50
6058B			2.50
6060			6.00
6062			1.50
6070			5.00
6072			4.00
6080			1.50

6082			2.00
6084			2.00
6086			2.75
6088			6.00
6090			1.50
6092			4.00
6094			2.00
6100			4.50
6102A			2.50

6102B			4.00
6102C			4.50
6104			3.00
6106			2.50
6110			1.00
6112			3.00
6114A			.35
6114B			.35
6116			1.00
6118			1.00
6120			.85

Page 485	Each	Page 485	Each
6130	\$ 5.00	6180	\$ 3.50
6132 (Red Binding)	3.00	6190	5.00
(Black ")	4.00	6192	6.00
6134	2.50	6194	3.00
6136	12.50	6196	6.00
6138	12.50	6198A	3.50
6140	8.00	6198B	5.00
6142	2.75	6198C	5.00
6144	1.50	6200	2.50
6146	5.00	6202	6.00
6148	1.00	6204	7.00
6150	4.50	6206	1.50
6152	7.00	6208	4.00
6154	2.50	6210	1.50
6160	6.00	6220A	4.00
6160 (Genuine Leather)	7.00	6220B	3.50
6162	6.00	6222	4.50
6164	6.00	6224	4.00
6170	6.00	6226	3.50
6172	4.50	6228	1.25
6174	5.00	6230	4.50

ALCO
QUALITY

**INSERT
BACK COVER OF PRICE LIST
INTO THIS POCKET**

